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Vol. 22 — No. 9

CONTENTS

Page

ORIGINAL PAPERS

Changes in Lateral Phorias with Vertical Changes in Fixation. Paul Connolly and Aloysius Koprowski . . . 399

Visual Discomfort Caused by Fluorescent Lighting. Edward I. Goodlaw . . . 406

A Case Report of Aniseikonia of Low Amount. Arene T. Wray . . . 425

Visual Functioning While Reading. George A. Parkins . . . 428

Comments on a "Delayed Subjective" Test. I. M. Borish . . . 433

EDITORIALS . . . 437

TRANSACTIONS OF THE ACADEMY . . . 439

ABSTRACTS . . . 440-450

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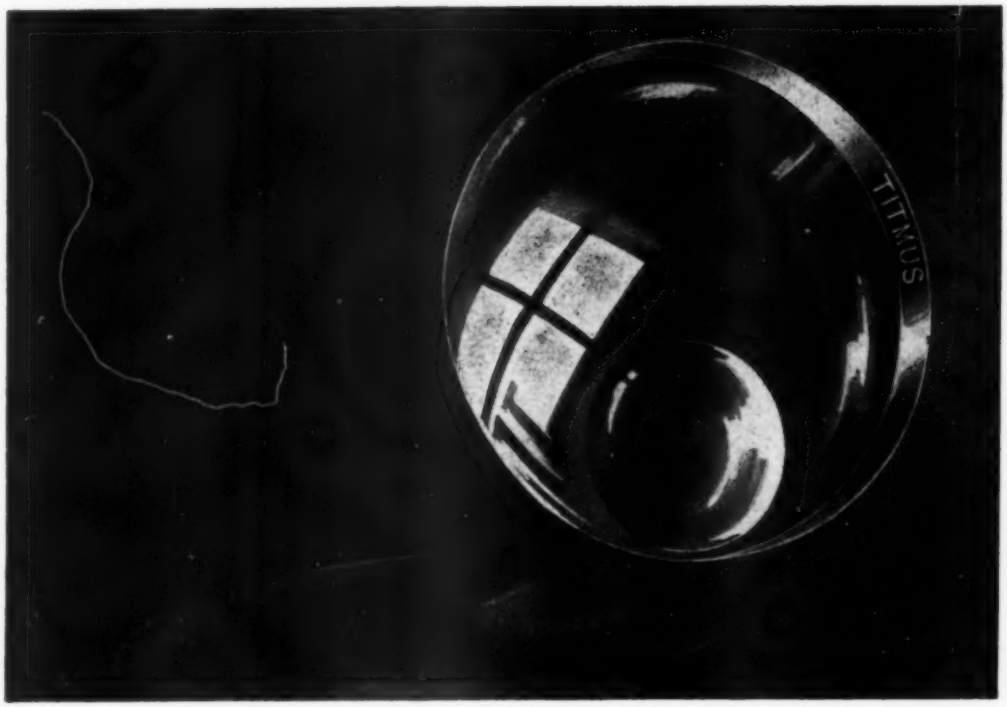

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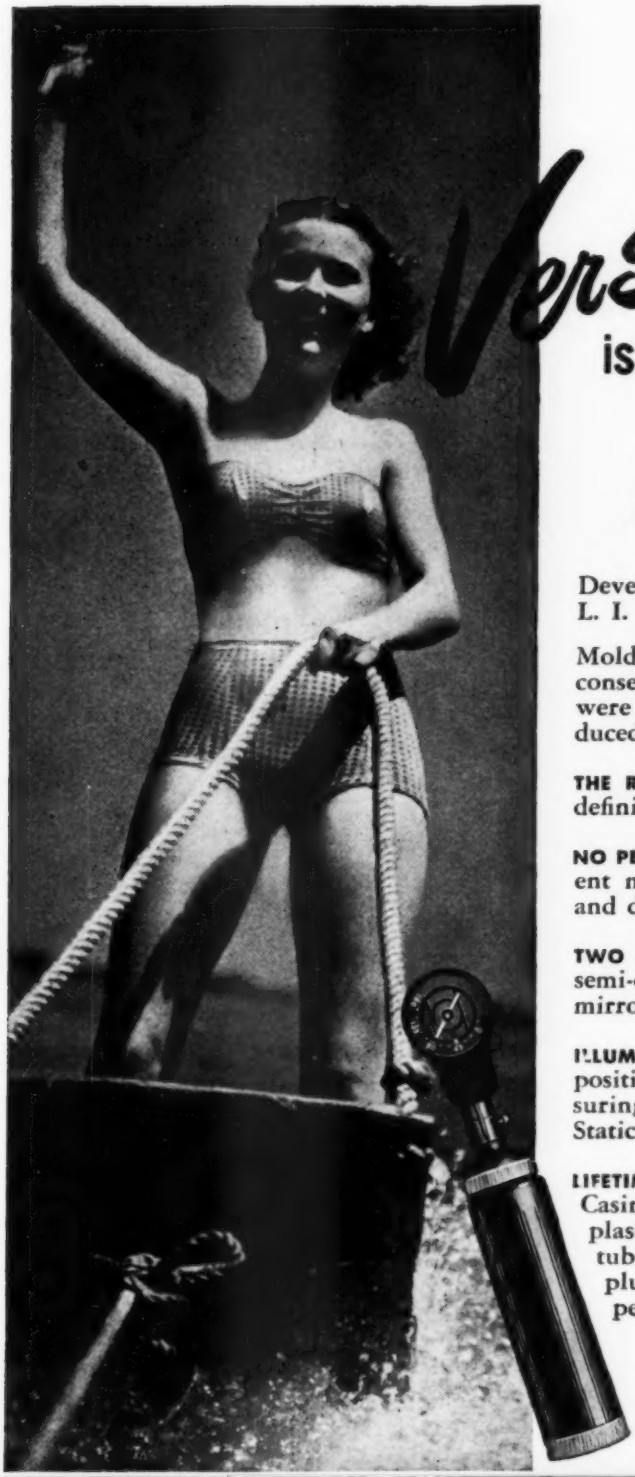

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CHANGES OF LATERAL PHORIAS WITH VERTICAL CHANGES OF FIXATION*

Paul Connolly, O.D., and Aloysius Koprowski, O.D.
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Philadelphia, Pennsylvania

INSTRUMENTATION

A standard type arc perimeter of known fixation distance, eleven inches, and with a constant source of illumination providing four foot-candles of light on the point of fixation, was used. The center wheel of the "Julius Neumueller Near Point Card" was used for the fixation target. This target is shown in Figure I.

The examinations were performed in a darkened room. This removed any stimulus to peripheral accommodation, and allowed the central accommodation to be stimulated by the fixation target.

The subjects wore the "Phorio-Frame" in the manner shown in Plates I and II. This original ophthalmic device incorporates an eight prism diopter lens base-down in the right eyewire, effecting constant vertical diplopia. A Rotary prism is inserted in the left eyewire so that lateral prism can be introduced.

FIGURE I.

The subjects examined were emmetropic, vertical orthophoric, and possessed a normal physiological exophoria. The subjects were positioned

* As the result of this original research, Drs. Connolly and Koprowski were awarded the Samuel N. Levitt Award of the Pennsylvania State College of Optometry. This work was completed during the first quarter of 1945. Submitted on June 14, 1945, for publication in the September, 1945, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

in the instrument so that the frontal plane of the face was vertical, and the eyes on line with the target when it was in the zero position. The target was moved up and down in the median plane of the head. The

PLATE I
SHOWING "PHORIO-FRAME" ON SUBJECT.

"Phorio-Frame" was so adjusted that the plane of the fixation line was always perpendicular to the plane of the frame.

With the eyes momentarily closed, sufficient base-out prism was introduced before the left eye to produce initial heteronymous diplopia. The base-out prism was reduced until the subject reported alignment of the vertical spurs. The eyes were again closed while the measurement was recorded. The same technique was followed using base-in prism which effected homonymous diplopia. Intermittent occlusion of the right eye of one-half second interim was performed throughout the technique. The readings were taken with the target placed from thirty degrees up

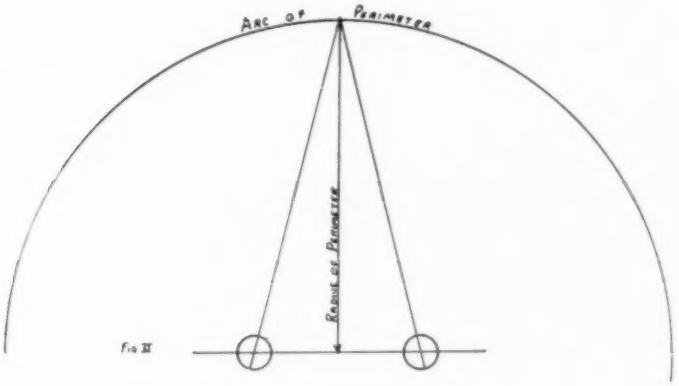


FIG II
SHOWING PLAN VIEW OF POSITIONING SUBJECTS IN FINDING LATERAL PHORIA CHANGES. PERIMETER IN 180th MERIDIAN

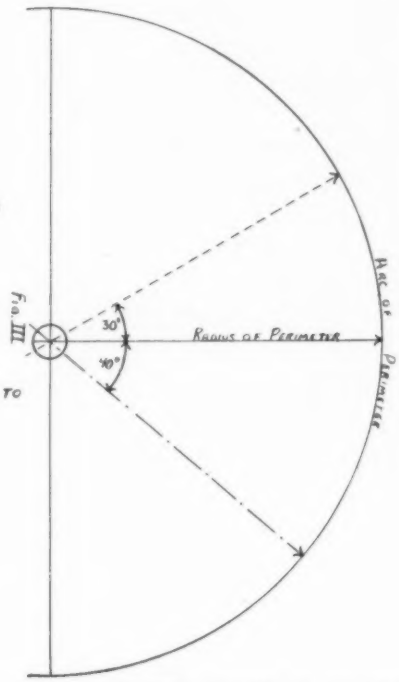


FIG III
SHOWIN SIDE VIEW OF POSITIONING SUBJECTS IN FINDING LATERAL PHORIA CHANGES. PERIMETER IN 90th MERIDIAN AS IN ENTIRE PROCEDURE. FIXATION DIRECTED FROM 30° ABOVE TO 40° BELOW, ON TARGET.

to forty degrees down, in ten degree steps. The readings on the rotary prism, in prism diopters, constitute the near exophoric changes. Following each alignment, the subjects closed their eyes momentarily to prevent fatigue resulting from the forced diplopia.

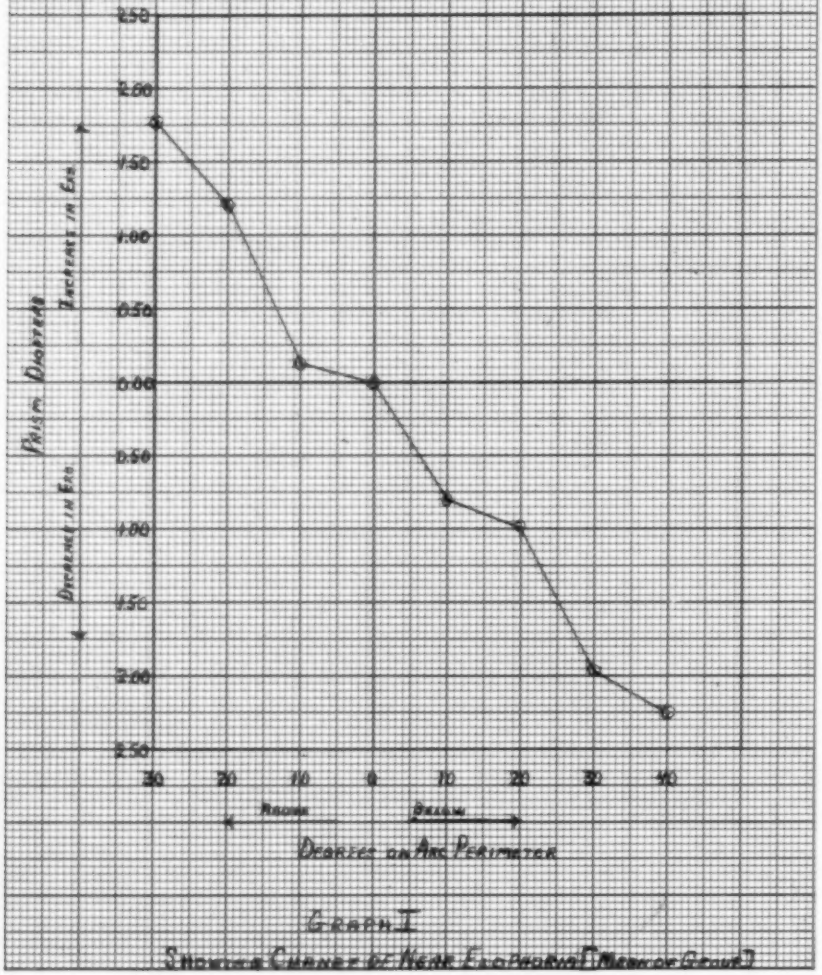
DISCUSSION OF FINDINGS

Changes of lateral phorias are definitely manifested by near fixations above and below the horizontal plane. It was noted in all subjects

Changes of Nine Esophoria

	Con(+)			Div(−)			Prism Diopters	
Fixation	1	2	3	4	5	6	7	Mean
30° above	+1.75	+1.75	+2.87	−0.50	+1.75	+1.25	−0.50	+1.77
20 "	+2.75	0.00	+2.87	+0.25	+.50	+1.00	0.00	+1.20
10 "	+1.25	−0.50	+1.12	+1.25	−0.50	−1.37	+0.37	+0.13
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 Below	+1.00	+2.00	+1.12	0.00	+0.25	+1.00	+0.25	+0.80
20 "	+1.25	+2.00	+0.62	+0.25	−0.25	+1.75	+0.75	+0.98
30 "	+2.00	+3.75	+0.62	+2.75	−0.25	+2.25	+2.62	+1.96
40 "	+1.00	+4.25	+0.62	+2.75	+1.00	+2.25	+3.87	+2.25

Table I.



Graph I.

Showing Curves of Near Esophoria (Mean of Group)

that there was an increase in the near exophoria with fixation above, and a decrease in the near exophoria with fixation below the horizontal plane.

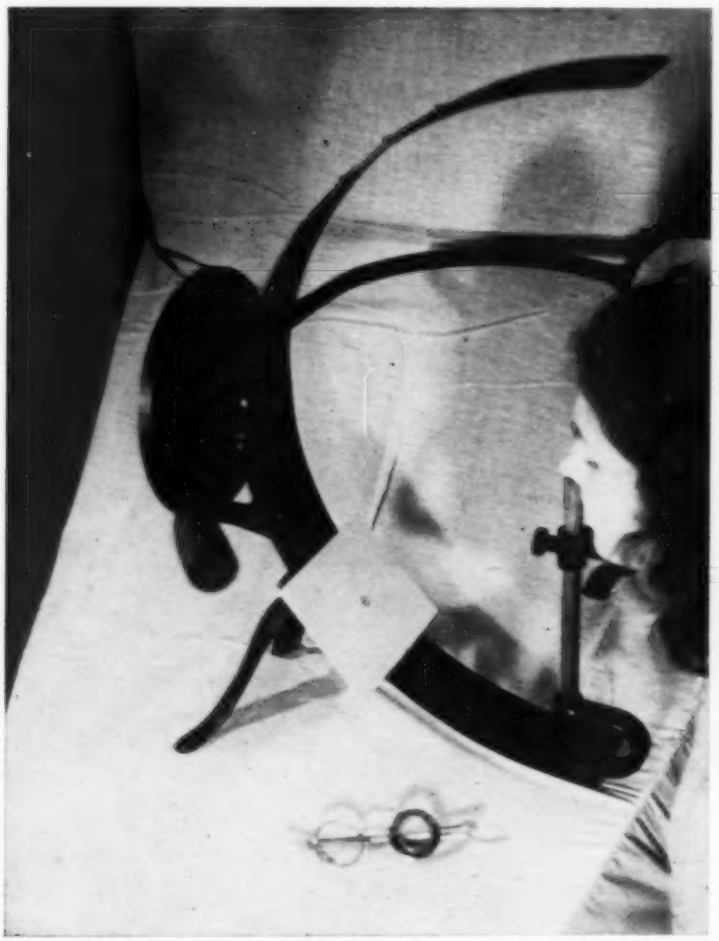


PLATE II

SUBJECT POSITIONED IN INSTRUMENT WITH FIXATION BELOW THE HORIZONTAL PLANE.

Although the exophoria change was in the same direction, the amount varied with the individual. The general trend of variance and the individual variations are presented in Graph I and Table I.

Other subjects were measured but some of the near exophorias fell outside the measuring limits of the fifteen degree rotary prism. However,

the general trend was like the cases cited herein. The average change of all the subjects was 4.02 prism diopters.

Accommodative changes are manifested also. The binocular push-

PLATE III
SUBJECT POSITIONED WITH "PHORIO-FRAME" WITH FIXATION ABOVE THE HORIZONTAL PLANE.

up method was used with the "Julius Neumueller Near Point Card" as the target. The target was pushed up to the eyes until a blurring of the fine double lines occurred. Upon lowering the target on an arc, a progressive clearing of the blurred design resulted; significant of a greater amount of accommodation being in force than at the point of blurring

in the horizontal position.

After pushing the target up binocularly to the closest distance at which it could be seen clearly, raising it on an arc resulted in a progressive blurring of the target; significant of less accommodation being in force than at the point where it was seen clearly in the horizontal position.

The amplitude of accommodation changes correspondingly when measured at these positions. There is less amplitude in superior gaze and greater amplitude in inferior gaze.

CONSIDERATIONS

The high exophoria at near, that is usually found in presbyopes, is reduced in inferior gaze and may account for the cases where muscular discomfort at the near point is absent in spite of the high exophoria. This change in the esophoric direction may also add to the discomfort that is experienced by persons possessing high esophorias when near point work is attempted.

CONCLUSIONS

The actual changes in the heterophoric position of the eyes, and the accommodative changes which occur when vertical fixation is varied, as found by our investigations, are listed below.

A. Fundamental Changes occurring in Superior Gaze.
   1. Increase in the Near Exophoria (decrease in the Near Esophoria.
   2. Decrease in Accommodation. (reflexly with divergence)

B. Fundamental Changes occurring in Inferior Gaze.
   1. Decrease in the Near Exophoria (increase in the Near Esophoria)
   2. Increase in Accommodation (reflexly with convergence)

Philadelphia, Pennsylvania

VISUAL DISCOMFORT CAUSED BY FLUORESCENT LIGHTING*

Edward I. Goodlaw, O.D.
Los Angeles, Calif.

The ever increasing use of fluorescent tube lighting in industry and business has made the study of the reaction of the human eye to this type of illumination an important one indeed. Extensive work has been done by illuminating engineers and lighting experts on the efficiency of this type of lighting, its ease of installation and maintenance, the various types of luminares and installations, its spectral qualities and so forth. These studies have incontrovertably proven a great many virtues which seem almost unique with this type of lighting. Its growing popularity is ample evidence that the illuminating experts recognize these virtues. Refractionists, on the other hand, have been almost as universal in their criticism. Repeated questioning by the author of his fellow optometrists has shown them to be quite antagonistic to fluorescent lights. Likewise, the author has been particularly impressed by the typical complaints almost universally expressed by those of his patients who work under fluorescent illumination. They complain of symptoms most commonly associated with glare; namely, the sandy gritty feeling of the eyes, the tenseness in the frontal region just above the eyes, and the general feeling of visual fatigue. The determination to find the answer to this vexing problem led to this investigation.

Glare has been defined as "misplaced light." It is recognized as light coming from sources other than the object in regard, and which tends to interfere with the proper contrast of this object's retinal image. It might be light entering the eye from the light source itself, as is the case where illuminants are not properly placed with respect to the visual tasks being performed. It might be light reflected from polished surfaces, or it might result from the object in regard being too highly illuminated in relation to the illumination of its surroundings.[1] In this case it is felt that too much light from the object is streaming into the eye for the particular state of adaptation, thereby giving rise to discomfort.

At first, the author suspected that this latter type of glare was ex-

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perienced by those working under fluorescent lights. To understand the reasoning employed requires a brief explanation of the mechanics of the fluorescent as opposed to the incandescent lamp.

An incandescent lamp gives off light because the electrical current forced through the highly resistant filament causes it to become white hot. However, much of this light is in the form of infra red heat radiation, which, of course, is not visible light at all. Theoretically[2] a tungsten bar at the melting point would yield an efficiency as high as 53 lumens per watt. Practically the highest efficiency of a standard lamp listed in the General Electric lamp catalogue is 35.8 lumens per watt and the lowest is 6.6 lumens per watt. Obviously, there is quite a time lag between the cessation of the flow of electricity and the cooling of the filament. This lag has proven to be an advantage in that it makes for steady light in spite of the almost exclusive use of alternate current.

The fluorescent tube, on the other hand, operates in an entirely different manner. When sufficient voltage is applied to a gas under reduced pressure the electrons given off at the cathode collide with the molecules of the gas imparting energy to their electrons.[3] These excited electrons, in returning to their normal position in the molecule, give off this energy in the form of light. However, the spectral quality of light given off in this manner is a characteristic of the gas used and is not necessarily the type best suited to good illumination. To achieve this the producer has incorporated with the above, the phenomenon of fluorescence. This phenomenon will be discussed more fully later. It is sufficient to note at this time that there is almost no lag between the cessation of electricity and of light. In using alternate current this then gives rise to a flicker and stroboscopic effect.[4] In certain parts of Canada,[5] in Midwestern United States, and on many farms, where home power units are employed, lower cycle alternate current is used—as low as 25 cycles. Here, even with the incandescent lights, the flicker is most pronounced yet no particular discomfort is experienced by those who have become accustomed to this lighting.

Further, careful checking on the installation of the lights under which some of our patients, who complained of these glare symptoms, worked disclosed that many of these installations were in Tulamp arrangements. Two tubes were used, one out of phase with the other reducing the flicker from 55 to 16 in the case of white lamps.[6] This reduction of flicker to less than one-third apparently had no effect on the symptoms of the patient.

We have gone into this discussion that the flicker phenomenon is the cause of patient discomfort (while not denying that it may be annoying) because this explanation still enjoys some popularity. However, as has been shown, it became necessary to investigate further.

As mentioned before, the fluorscent tube being a form of vapor discharge lamp, must have the addition of fluorescent powders to control the spectral quality of the light. Certain materials when impinged by ultra violet light with the peak at 2537 Angstrom units absorb this ultra violet light only to remit it again in the visible region of the spectrum.[7]. By choosing these materials carefully the makers of fluorescent lamps have been very successful in obtaining the spectral quality of light desirable such as daylight or white, etc. Depending thus upon fluorescent to produce the light, it was desirable to have the vapor arc discharge as little visible light and as much ultra violet light, especially that around the 2,537 A line, as possible. This is exactly what the manufacturer has done.[8] It is upon this possibility, we believe, that the explanation for the glare symptoms on the part of our patients could be found. A considerable portion of these near violet rays emitted by the act is not absorbed by the fluorescing powders or the glass of the tube, but is transmitted into space. These, when entering the eye, cause the lens of the eye to fluoresce and re-emit visible light. In 1855 Helmholtz studied the application of fluorescence to the eye. He showed that when rays from 3,000 to 4,000 Angstrom units were passed through the arc is not absorbed by the fluorescing powders or the glass of the spectral region for its production is between 3,700 and 3,900 Angstrom units, the maximum being 3,850, while below 3,500 little or none is observed.[10] The eye media thus acts as a source of glare which cannot be avoided. A procedure was then considered to prove or disprove this contention.

Meredith W. Morgan, in his studies of accommodation with the haploscope, has shown that near the limits of the accommodative mechanism the eye can continue to achieve clear vision by virtue of the caustic caused by the spherical aberration of its optical system.[9] From this it can readily be seen that any disturbance in the contrast of the retinal image, such as glare, would affect this latter phase of accommodation resulting in a lowered measureable accommodative amplitude. If the eye can compensate for this increase in light by decreasing the size of the pupil, this depth of focus should increase and a greater accommodative amplitude might be measured. We, therefore, decided to study the retinal

image in terms of accommodative amplitude as measured by the "push up" test. We felt that it offered an accurate clue as to what was going on in the eye, whereas tests such as visual acuity might be complicated by the variables of recognition, perception, etc.

The question of fatigue has been thoroughly investigated by Dr. H. W. Hofstetter. In his ergographic studies of accommodation[11] he showed that fatigue occurred monocularly only after many repeated "push ups" with complete recovery within a few seconds. This would mean that fatigue would probably be a minor variable in our procedure deserving some consideration.

Essentially our method consisted of measuring the accommodative amplitude by bringing the word "Optometrist" printed in 6 point type on a small white card towards one eye at a steady rate from a position 16 inches away and recording in inches from the eye that point at which the word blurred out. The other eye was covered with an opaque patch. The patient wore contact lenses fitted to him with which he obtained 20/20 vision in each eye. The measurements were taken first while wearing the contact lenses with a solution of 2% Sodium Bicarbonate. Then they were repeated with 1% Sodium Fluorescin mixed in the Sodium Bicarbonate.

Sodium Fluorescin is a dye which is highly fluorescent under ultra and near violet light. In this way we were able to study the reaction of the eye as expressed in the accommodative amplitude under the various types of lighting conditions with and without the effect of a known fluorescent body directly before the eye.

Before the experiment was begun the patient took 20 minutes to become adapted to the illumination of the room. The importance of this was shown by Dr. Miles A. Tinker.[12] In each instance, each eye was examined separately, two or three practice trials were run, then five recordings were made.

Our investigation was divided into two parts. In the first part we wanted to know: (1) how accurately the accommodative amplitude measured the response of the eye under the most ideal conditions; (2) what difference there might be under these conditions in the response of the eye when a 100 watt daylight incandescent bulb, rated by GE at about 3,500° Kelvin, was used as compared to that when a white 20 watt fluorescent tube, rated also at about 3,500° Kelvin was used, and (3) the effect of the fluorescin. We equalized the illumination on the target under the incandescent light and the fluorescent tube by varying

the distance of the source of illumination from the target and checking (part one) with a brightness meter.

In the second part of our investigation we were interested in determining the response of the eye, with and without Fluorescin, to various degrees of glare using the daylight incandescent bulb as the glare source as compared to a glare of the same intensity using a 20 watt white fluorescent tube and a 20 watt daylight fluorescent tube rated at about 6000° Kelvin. During this procedure all intensities of illumination were checked with a GE Photometer, and the intensity was varied by changing the distances of the light source. In both parts all other lights were out except either the incandescent bulb or the fluorescent tube or both.

The results obtained were as follows:

PART 1. All accommodative amplitudes were recorded in inches, which of course, when expressed in meters, is the reciprocal of the accommodation used.

(1) With the daylight incandescent bulb placed behind and above the patient to eliminate all shadows and the brightness of the target at 5″ from the eye was 11 ft. Lamberts. Clear 2% $NaHCO_3$ solution in distilled water being used in the contact lens:

LE—7″	7″	7″	7¼″	7¼″	Average 7.1″
RE—7¼″	7¾″	7¼″	7¼″	7¾″	Average 7.45″

With 1 drop of Sodium Fluorescin added to the 2% $NaHCO_3$ solution:

LE—6¼″	6½″	6¼″	6¼″	6¼″	Average 6.3″
RE—6″	6¼″	6¼″	6¼″	6¼″	Average 6.2″

With 2 drops of 1% Sodium Fluorescin added to the 2% $NaHCO_3$ solution:

LE—5½″	5½″	5½″	5½″	5½″	Average 5.5″
RE—5¼″	5½″	5¾″	5¼″	5¼″	Average 5.4″

With 3 drops of 1% Sodium Fluorescin added to the 2% $NaHCO_3$ solution:

LE—4½″	4½″	4½″	4½″	4½″	Average 4.5″
RE—4½″	4½″	4¾″	4¾″	5″	Average 4.7″

(2) With a 20 watt white fluorescent tube rated at 3500° Kelvin placed behind and above the patient to eliminate shadows at such distance that the brightness of the card was 11 ft. Lamberts when held 5″ from the eye.

Also using clear 2% solution of Sodium Bicarbonate in distilled water in the contact lens we found:

LE—4½″	4¾″	4½″	4¾″	4¾″	Average	4.81″
RE—4¾″	4½″	4¾″	5″	4¾″	Average	4.75″

1 drop of 1% Sodium Fluorescin added to the 2% solution of $NaHCO_3$ in the contact lenses:

LE—4⅝″	4⅝″	4⅝″	4⅝″	4⅝″	Average	4.625″
RE—4¼″	4¼″	4⅝″	4⅝″	4⅝″	Average	4.48″

2 drops of 1% Sodium Fluorescin added to the 2% solution of $NaHCO_3$ in the contact lenses:

LE—4¼″	4¼″	4¼″	4¼″	4⅝″	Average	4.33″
RE—4¼″	4¼″	4¼″	4¼″	4¼″	Average	4.25″

3 drops of 1% Sodium Fluorescin added to the 2% solution of $NaHCO_3$ in the contact lenses:

LE—4¼″	4½″	4⅜″	4⅜″	4⅜″	Average	4.38″
RE—4″	4″	4⅛″	4″	4⅛″	Average	4.05″

While the patient had his lenses on with the 3 drops of Sodium Fluorescin we disgressed by moving the fluorescent tube from behind the patient to his right at a position about 90° from his visual axis. The brightness of the card from the position of the patient was 1.2 ft. Lamberts. We found the blur out position to be:

RE—5⅜″	5⅜″	5½″	5½″	5½″	Average	5.45″
LE—4″	4″	4″	4″	4″	Average	4″

replacing the fluorescent tube with the incandescent bulb:

RE—4¾″	4⅞″	4¾″	4⅞″	4⅞″	Average	4.83″
LE—4¾″	4¾″	4¾″	4⅝″	4⅝″	Average	4.63″

Having found this rather decided difference in response in the last two determinations under fluorescent lighting and incandescent, we had the patient remove the lenses. We cleaned them, and he put them back with clear 2% $NaHCO_3$ solution. Then he removed them and reinserted them with clear solution thereby washing not only the lenses but his eyes as well. Now the same determintions were repeated.

First with the incandescent light at 90° to the visual axis with a brightness on the test card of about 1.3 ft. Lamberts:

RE—4¾″	4⅞″	4¾″	4⅞″	4⅞″	Average	4.83″
LE—4¼″	4¼″	4¼″	4¼″	4⅝″	Average	4.33″

then using the fluorescent tube at 90° to the visual axis with the illumination reading at 1.25 ft. Lamberts on the test card:

RE—5⅛″	5⅛″	5⅛″	5⅛″	5⅛″	Average	5.125″
LE—4″	4″	4″	4″	4″	Average	4″

PART 1 FIGURE 1

No. of drops of 1% Sodium	Trial No.	Incandescent		Fluorescent		Difference Incandescent *vs.* Fluorescent		Location of Light and Illumination
Fluorescin added to 2% $NaHCO_3$		L	R	L	R			
Clear	1	7.1	7.45	4.81	4.75	2.3	2.7	Both Lights Behind Brightness of Target 11 ft. Lamberts
1 Drop	2	6.3	6.2	4.58	4.48	1.7	1.7	
2 Drops	3	5.5	5.4	4.33	4.25	1.2	1.1	
3 Drops	4	4.5	4.7	4.38	4.05	0.1	0.6	
3 Drops	5	4.83	4.63	5.45	4.0	−0.7	−0.6	Light at 90° to Visual Axis 1–2 ft. Lamberts
Clear	6	4.33	4.83	5.125	4.0	−0.8	−0.8	
	Difference between Left and Right eye, with							
						Fluorescent	Incandescent	
3 Drops						1.5	0.2	
Clear						1.1	−0.5	

PART 2 FIGURE 2

Solution	Trial No.	Incandescent		Fluorescent		Difference		Light Above and Behind Patient
Clear Solution or Sodium Fluorescin added		RE	LE	RE	LE	RE	LE	
Clear	1 and 2	5.7	5.3	5.0	4.7	0.7	0.5	Illumination on Target
3 Drops	3 and 4	4.5	4.5	4.4	4.4	0.1	0.1	4 ft. Candles

Solution	Trial No.	Position of Glare Source								Light Used	
Clear Solution or Sodium Fluorescin added		90°		45°		30°		0°		Glare	Illuminant
		LE	RE	LE	RE	LE	RE	LE	RE		
3 Drops	5	3.7 3.6	3.8	4.2	4.6	4.9	4.6	6.9	7.6	3500° Kelvin Fluorescent	3500° Kelvin Incandescent
3 Drops	6	4.6	4.4	4.4	4.4	4.5	4.5	4.9	5.0	Incandescent	3500° Kelvin Fluorescent
Clear	7	4.5	4.5	4.6	4.5	4.5	4.6	4.5	4.5	Incandescent	3500° Kelvin Fluorescent
Clear	8	4.5	4.5	4.7	4.9	5.3	5.5	6.4	6.3	3500° Kelvin Fluorescent	Incandescent
3 Drops	9			6.4	6.6	6.9	7.0	7.5	7.5	6000° Kelvin Fluorescent	Incandescent
Clear	10			6.0	6.0	6.5	6.5	7.0	7.2	6000° Kelvin Fluorescent	Incandescent
Clear	11			5.7	5.8	6.2	6.1	6.3	6.1	Incandescent	3500° Kelvin Fluorescent

From the results of this first part of our experiment we might draw certain conclusions:

1. The first set of determinations showed an increase in the accommodative amplitude—from 7.1 for the left eye and 7.45 for the right to 4.5 for the left eye and 4.7 for the right in the last determination under the incandescent illuminant. When the same procedure was repeated using the fluorescent tube as an illuminant comparatively little change in the amplitude could be observed—from 4.81 in the left eye and 4.75 in the right to 4.38 in the left and 4.05 in the right, in the last determination. This can be seen both in the tables of Figure 1 and in the graph of Figure 3. This discrepancy can hardly be explained by any difference which might exist in the two types of light source. First, the greatest increase took place while the incandescent light was used and remained almost constant with the fluorescent. Any differences due to the light source should be shown by a difference in the findings when we changed from one source to the other. Second, the only light entering the eye was that reflected from the paper target. We found, with the brightness meter, that the intensity of this reflected light remained constant, and because it was reflected we could expect the other qualities to remain nearly constant. Third, in the subsequent determinations shown later in this report, under comparable conditions, the accommodative amplitude always remained higher than the first result. (Part 2 trials 1 to 4 shown in Figure 2.) Hofstetter in his work on the accommodation ergograph[13] shows that this can be explained by a sort of "warming up" of accommodation after which the amplitude would remain constant. Fatigue after about 1½ hours still did not appear as a factor.

2. As long as the light entering the eye was reflected from the test card the presence of Sodium Fluorescin had little effect, as far as the type of light source used was concerned. With three drops of Fluorescin we found LE 4.5 and RE 4.7 under incandescent, while with fluorescent we found a slight advantage as shown by LE 4.3 and RE 4.0. It might be of interest to point out here that white paper reflects very little ultra violet light.

3. As soon as light entered the eye from the light source itself, even to the slightest degree, the presence of Sodium Fluorescin brought about a greater reduction of the amplitude under fluorescent light. Where the nose acted as a shield to keep the right eye in shadow when the fluorescent tube was at 90° to the visual axis on the left we found RE 4.0 and LE 5.45.

4. This effect was noticeable to a slightly lesser degree even when clear solution was used in the contact lens when the fluorescent tube was placed at 90° to the visual axis to the left. We found RE 4.0 and LE 5.125.

5. When the incandescent light was placed at 90° to the visual axis to the left we found very little difference in the accommodative amplitude in the right and left eye when either clear or Sodium Fluorescin solution was used. With clear solution we found RE 4.83 and LE 4.33 and with Sodium Fluorescin we found RE 4.63 and LE 4.33.

These figures are shown tabulated in Figure 1, Trials 5 and 6, as well as the differences involved. They are illustrated in the graph of Figure 4.

The second part of the investigation was conducted one week later. We felt it would have been very undesirable to continue the findings in one sitting as the patient, as well as the refractionist, became fatigued. We also decided to perform each series in one sitting because of the factor considered in Number 1 of the above conclusions.

In this second series we were interested in determining the effect of fluorescent lighting as compared to incandescent when acting as a glare source while the target illumination remained constant. As a matter of greater convenience and speed we used a GE Photometer instead of a brightness meter. The brightness of the target was maintained by positioning the light behind the patient so that its angle of incidence was the same in each case, and at such distance that the candle power of the light falling upon the target was kept constant. However, it might be well to note that as long as the general illumination was constant the brightness of the target was a rather small factor. In the first part where the incandescent bulb was used in conjunction with the 3 drops of Fluorescin in the contact lens, with the light behind the patient and the target brightness of 11 ft. Lamberts, we found RE 4.70 and LE 4.50. When we moved the incandescent light to a position 90° from the visual axis, we held the general illumination constant by keeping the distance of the light from the target the same, we lowered the brightness of the target to 1.3 ft. Lamberts by this change in incidence of the light on the target, yet the amplitude measurements were RE 4.83 and LE 4.63. This means only a very slight reduction in the actual amplitude of accommodation.

No. 1. Repeating the first part of part one to overcome the "warm up period" (which was faster in the second sitting), illumination on

the target was set at 4 ft. candles, the 100 watt incandescent lamp behind and above the patient was about 50 inches from the target. Contact lenses inserted with clear $NaHCO_3$:

RE—5¾″	5¾″	5½″	5¾″	5¾″	Average 5.7″
LE—5¼″	5¼″	5¼″	5¼″	5¼″	Average 5.25″

No. 2. Using the 3500° Kelvin white fluorescent tube placed behind and above the patient with illumination at 4 ft. candles:

RE—5″	5″	4⅞″	5″	5″	Average 4.98″
LE—4⅝″	4¾″	4¾″	4¾″	4¾″	Average 4.73″

No. 3. Repeating No. 1—Using the incandescent behind and above the patient with illumination on the target of 4 ft. candles. $NaHCO_3$ in contact lenses with 3 drops of 1% Sodium Fluorescin:

RE—4½″	4⅜″	4½″	4½″	4½″	Average 4.48″
LE—4½″	4½″	4⅜″	4⅜″	4½″	Average 4.45″

No. 4. Repeating No. 2—The fluorescent tube was above and behind the patient with illumination of 4 ft. candles. 2% $NaHCO_3$ solution in contact lenses with 3 drops of 1% Sodium Fluorescin:

RE—4⅜″	4⅜″	4½″	4⅜″	4⅜″	Average 4.4″
LE—4⅜″	4⅜″	4⅜″	4⅜″	4⅜″	Average 4.38″

No. 5a. Placing the incandescent light above and behind the patient with the fluorescent tube to the left at 90° from the visual axis so that illumination on the target was 18 ft. candles total and the light from the fluorescent tube was 10 ft. candles. Using 3 drops of 1% Sodium Fluorescin with the 2% solution of $NaHCO_3$ in the contact lenses:

LE—3⅝″	3⅝″	3⅝″	3⅝″	3¾″	Average 3.65″
RE—3¾″	3¾″	3¾″	3¾″	3¾″	Average 3.75″

Repeating for the left eye again:

3⅝″	3⅝″	3½″	3½″	3⅝″	Average 3.58″

No. 5b. With all the other factors the same, the fluorescent tube was placed at 45° to the visual aixs, 46½ inches from the eye, giving an illumination of 10 ft. candles at the eye:

LE—4⅛″	4⅛″	4¼″	4¼″	4⅛″	Average 4.18″
RE—4⅝″	4⅝″	4⅝″	4½″	4½″	Average 4.58″

No. 5c. With all the other factors the same, the fluorescent tube was placed at 30° from the visual axis giving an illumination of 10 ft. candles at the eye:

LE—4⅞″	4¾″	4⅞″	4⅞″	4⅞″	Average 4.85″
RE—4¾″	4¾″	4½″	4½″	4⅝″	Average 4.63″

No. 5d. With all the other factors constant and placing the fluorescent tube on the visual axis giving an illumination of 10 ft. candles to the eye:

LE—6⅞″	6⅞″	7″	6⅞″	6⅞″	Average 6.9″
RE—7½″	7½″	7½″	7⅞″	8″	Average 7.63″

No. 6a. Placing the 3500° Kelvin fluorescent tube behind and above the patient to illuminate the target to 18 ft. candles. The daylight incandescent bulb (3500° Kelvin) was placed at 90° from the visual axis giving 10 ft. candles at the eye. 3 drops of 1% Sodium Fluorescin was added to the clear 2% $NaHCO_3$ solution in the contact lenses:

LE—4⅝″	4⅝″	4⅝″	4½″	4⅝″	Average 4.6″
RE—4⅜″	4⅜″	4⅜″	4⅜″	4⅜″	Average 4.38″

b. With all the other factors constant, the incandescent bulb was moved to an angle of 45° with the visual axis giving 10 ft. candles at the eye:

LE—4⅜″	4¼″	4⅜″	4⅜″	4⅜″	Average 4.35″
RE—4⅜″	4⅜″	4⅜″	4⅜″	4½″	Average 4.4″

c. With all other factors constant, the incandescent bulb was moved to 30° with the visual axis giving 10 ft. candles of illumination at eye:

LE—4½″	4½″	4½″	4⅝″	4½″	Average 4.52″
RE—4½″	4½″	4½″	4½″	4½″	Average 4.5″

d. With all other factors constant, the incandescent bulb was moved to 0° with the visual axis giving 10 ft. candles illumination at the eye:

LE—4¾″	4⅞″	4⅞″	4⅞″	5″	Average 4.88″
RE—5″	5″	5″	5″	5″	Average 5.0″

No. 7a. The contact lenses were removed, washed, and reinserted with clear 2% solution of $NaHCO_3$. They were then removed again, washed, and again reinserted with clear 2% solution of $NaHCO_3$. The fluorescent tube was left in the same position as in No. 6 and the incandescent bulb was placed at 90° to the visual axis. The same illuminations were maintained:

LE—4½″	4½″	4½″	4½″	4½″	Average 4.50″
RE—4½″	4⅝″	4½″	4½″	4½″	Average 4.53″

b. Incandescent bulb at 45°, all other factors constant:

LE—4⅝″	4⅝″	4⅝″	4½″	4⅝″	Average 4.60″
RE—4½″	4⅜″	4½″	4½″	4½″	Average 4.48″

c. Incandescent bulb at 30°, all other factors constant:

LE—4½″	4⅝″	4½″	4½″	4½″	Average 4.53″
RE—4⅝″	4⅝″	4⅝″	4⅝″	4⅝″	Average 4.63″

d. Incandescent bulb at 0°, all other factors constant:

LE—4½″	4½″	4½″	4⅝″	4½″	Average 4.53″
RE—4½″	4½″	4½″	4½″	4½″	Average 4.50″

No. 8a. The lights were rearranged so that the incandescent bulb was behind and above the patient and the fluorescent tube became the glare source. Clear 2% $NaHCO_3$ solution was used in the contact lenses. With the fluorescent tube at 90°—illumination on target was 18 ft. candles and from the tube it was 10 ft. candles at the eye:

LE—4½″	4½″	4½″	4½″	4½″	Average 4.50″
RE—4½″	4½″	4½″	4½″	4½″	Average 4.50″

b. Fluorescent tube at 45°, all other factors constant:

LE—4⅝″	4¾″	4⅝″	4⅝″	4¾″	Average 4.68″
RE—4⅞″	5″	5″	4⅞″	4⅞″	Average 4.93″

c. Fluorescent tube at 30°, all other factors constant:

LE—5¼″	5¼″	5¼″	5¼″	5¼″	Average 5.25″
RE—5½″	5½″	5½″	5½″	5½″	Average 5.50″

d. Fluorescent tube at 0°, all other factors constant:

LE—6⅜″	6⅜″	6⅜″	6⅜″	6⅜″	Average 6.38″
RE—6¼″	6¼″	6⅜″	6⅜″	6⅜″	Average 6.33″

No. 9. The contact lenses were now removed and reinserted with 3 drops of 1% Sodium Fluorescin and 2% solution of $NaHCO_3$. The incandescent bulb was left in the same place but the 3500° Kelvin white fluorescent tube was replaced with a 6000° Kelvin Daylight fluorescent tube to act as the glare source. Care was exercised to maintain the illumination on the target at 18 ft. candles and from the glare source 10 ft. candles at the eye.

a. With the 6000° Kelvin fluorescent tube at 45° from the visual axis:

LE—6⅜″	6¼″	6⅜″	6⅜″	6⅜″	Average 6.35″
RE—6½″	6⅝″	6⅝″	6½″	6½″	Average 6.55″

b. With the 6000° Kelvin fluorescent tube at 30° with the visual axis:

LE—6⅞″	6⅞″	7″	7″	6⅞″	Average 6.93″
RE—7″	6⅞″	7″	7″	7″	Average 6.98″

c. With the 6000° Kelvin fluorescent tube at 0° with the visual axis:

LE—7½″	7½″	7½″	7½″	7½″	Average 7.50″
RE—7½″	7½″	7½″	7½″	7½″	Average 7.50″

No. 10. The contact lenses were removed, washed and reinserted with clear 2% $NaHCO_3$ solution. Removed, washed and again reinserted with clear 2% $NaHCO_3$ solution. The incandescent bulb remained in the same position as in No. 9 and the 6000° Kelvin fluorescent tube was positioned as the glare source. Care was exercised to maintain the same illumination.

a. Fluorescent tube at 45°:

LE—6″	6″	6″	6⅛″	6″	Average 6.03″
RE—6″	6″	6″	6″	6″	Average 6.00″

b. With the fluorescent tube at 30°:

LE—6½″	6½″	6½″	6½″	6½″	Average 6.50″
RE—6½″	6½″	6½″	6½″	6½″	Average 6.50″

c. With the fluorescent tube at 0°:

LE—6⅞″	6⅞″	7″	7″	7″	Average 6.95″
RE—7⅛″	7¼″	7⅛″	7⅛″	7⅛″	Average 7.15″

No. 11. By this time it had taken us 2 hours and 15 minutes to

make the above determinations, so we felt a repeat to check the effect of fatigue was in order. The contact lenses with the clear 2% solution of $NaHCO_3$ remained on the eyes. The white 3500° Kelvin fluorescent tube was mounted behind and above the patient and the incandescent bulb was used as a glare source. Thus we duplicated the conditions in No. 7.

a. The incandescent bulb at 45°:

LE—5¾″	5½″	5¾″	5¾″	5¾″	Average 5.70″
RE—5¾″	5¾″	5¾″	5¾″	5¾″	Average 5.75″

b. The incandescent bulb at 30°:

LE—6⅛″	6⅛″	6⅛″	6⅛″	6¼″	Average 6.15″
RE—6⅛″	6⅛″	6⅛″	6⅛″	6⅛″	Average 6.13″

c. With the incandescent bulb at 0°:

LE—6¼″	6¼″	6¼″	6¼″	6¼″	Average 6.25″
RE—6⅛″	6⅛″	6⅛″	6⅛″	6⅛″	Average 6.13″

In analyzing our findings, it might be well to discuss some of the factors which affected them other than the primary consideration of glare here under scrutiny.

1. We have already discussed the "warm up" period of accommodation as shows in part one in Figure 3.

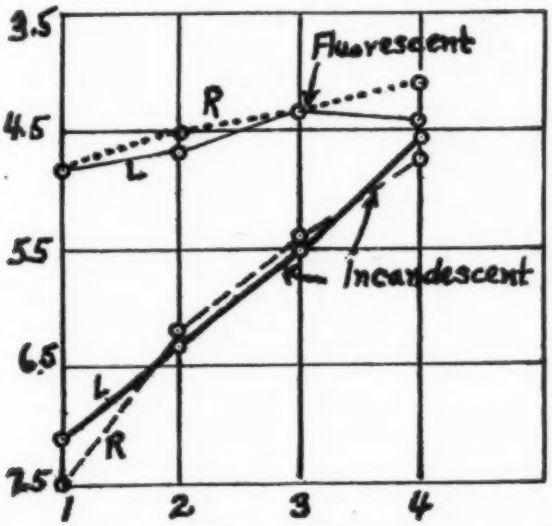

Figure 3. Part 1. Trials 1 to 4. Amplitude at left. Trial Number at bottom.

2. Another factor which we discussed but apparently failed to guard against sufficiently was the state of light adaption of the eye while taking findings for comparison. In part 2 trials 1 to 4 we worked under a general illumination of 4 ft. candles. We then went immedi-

ately into trial 5 without waiting for adaptation to take place. In trial 5 the illumination from the Illuminant was about 18 ft. candles and from the glare source it was about 10 ft. candles, making a total of nearly 28 ft. candles, which was quite a jump from 4 ft. candles. Of course the pupils contracted, the depth of focus increased and the accommodative amplitude jumped way up. To verify this we repeated the measurement on the left eye twice. As we proceeded with the experiment the adaptation of the eye coupled with the increase in glare produced a very marked reduction in the accommodative amplitude. This can be seen in the solid line which is the curve for the left eye in Figure 5. To avoid confusion we plotted the curves for the left eye only in Figures 5, 6, and 7. From the table of Figure 2 we might point out that the accommodative amplitude dropped from LE 3.65 to LE 6.9 and RE 3.8 to RE 7.6. This variable of adaptation would render the first few findings of part 2 trial 5 questionable while comparing on the factor of glare alone with the findings of the other trials. Though the lack of this data in no way materially affects the strength of the evidence presented, the phenomenon here shown is worthy of note.

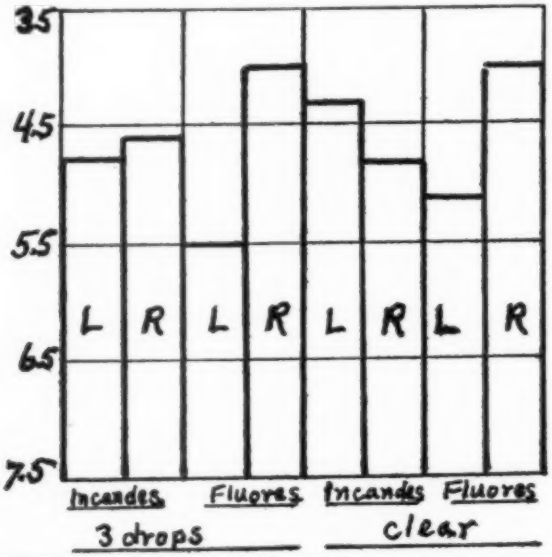

Figure 4. Part 1. Trials 5 and 6. Amplitude at left.

3. The third factor is that of fatigue. This factor is nicely shown in trials 7 and 11, the latter being a repetition of the former at the end of the experiment. As can be seen in Figure 7 the relative slope of the lines remains constant. This would indicate that fatigue is not a vari-

able worthy of consideration in the course of each trial run. It would be of little consequence in comparing the results of the trials close together chronographically but would be an important consideration if we were comparing one trial at the beginning of the experiment with another run at the end.

Glare has long been known to be the cause of great discomfort to the eye. It is interesting to note that when the incandescent bulb was used as a glare source, though the patient reported some discomfort, it had comparatively little effect on the accommodative amplitude with or

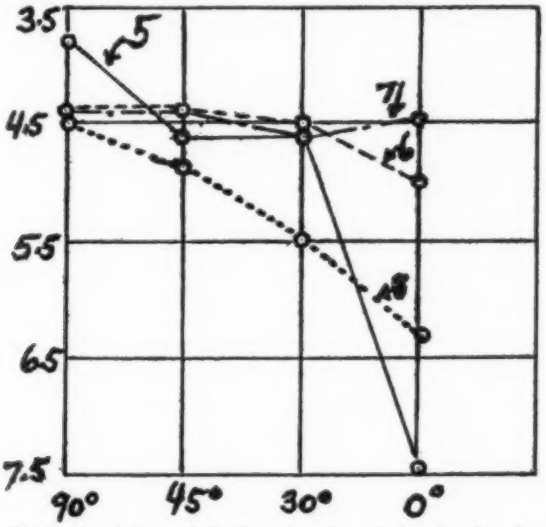

Figure 5. Part 2. Trials 5, 6, 7 and 8. Amplitude at left. Angle of glare source curves for left eye only, at bottom.

without Fluorescin. This is shown as the dot and dash line for trial No. 7 and the dash line for trial No. 6 in Figure 5. As the bulb was moved from 90° to the visual axis to a position directly in front of the patient the blur out point was RE 4.4 and LE 4.6, to RE 5.0 and LE 4.9 with 3 drops of Sodium Fluorescin, and RE 4.5 and LE 4.5 to RE 4.5 and LE 4.5 with clear solution. We see, therefore, that the eye was able to make adaptations to maintain its normal function. However, it might be well to point out that, though the response was unaffected, increased glare in this manner can in no way be considered an hygienic arrangement for the eye. With fluorescent light as a glare source of exactly the same intensity of illumination, the eye was unable to compensate and loss of function was the result. If we consider only the findings with the glare source at 0° in trial 5 and 6 discarding the other measurements for comparison due to this factor of adaptation, we see that with Fluor-

escin the blur out point with the fluorescent tube as a glare source was LE 6.9 and RE 7.6, while under the same conditions with the incandescent bulb it was LE 4.9 and RE 5.0 and with the 6000° Kelvin fluorescent tube it was LE 7.5 and RE 7.5. Choosing this position in which the glare source is on the visual axis, we obtain a maximum effect of the glare itself and reducing the effect of all the other variables to a minimum. Without the fluorescin this increased effect of glare with fluorescent light is still definitely apparent but not quite as pronounced. Using a clear solution in the contact lens and the incandescent bulb as a

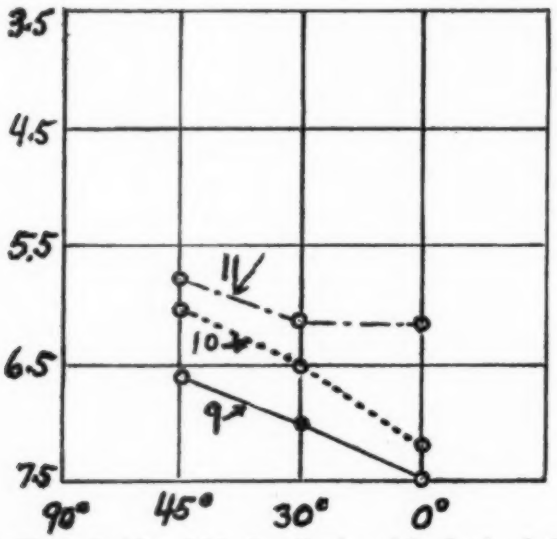

Figure 6. Part 2. Trials 9, 10 and 11. Amplitude at left. Angle of glare source curves for left eye only, at bottom.

glare source right on the visual axis the blur out point is LE 4.5 and RE 4.5, with the 3500° Kelvin fluorescent tube it is LE 6.4 and RE 6.3 while with the 6000° Kelvin fluorescent tube it is LE 7.0 and RE 7.2. This is shown in Figures 5 and 6, as well as in Figure 2. The reduction in accommodative amplitude is greatest where a daylight fluorescent tube acts as a glare source, a bit less where a white fluorescent tube acts as a glare source and less where the incandescent bulb acts as a glare source. This comparison is further exaggerated when Fluorescin is used in the contact lens. Such a relationship would be expected if our original suspicion that the fluorescence of the media of the eye caused by the particularly high radiation of light from 3000 A to 4000 A in the fluorescent tube as compared to that radiated by the incandescent bulb acted as a glare source to which the eye could make no adequate adjustment. The further

loss of function of the eye when the Fluorescin was used, though it was small in amount but nevertheless consistent, shows that it too became an additional source of glare as it fluoresced making it still harder for the eye to compensate. The Daylight 6000° Kelvin fluorescent tube emits still more of the blue and near violet light than either the white 3500° Kelvin

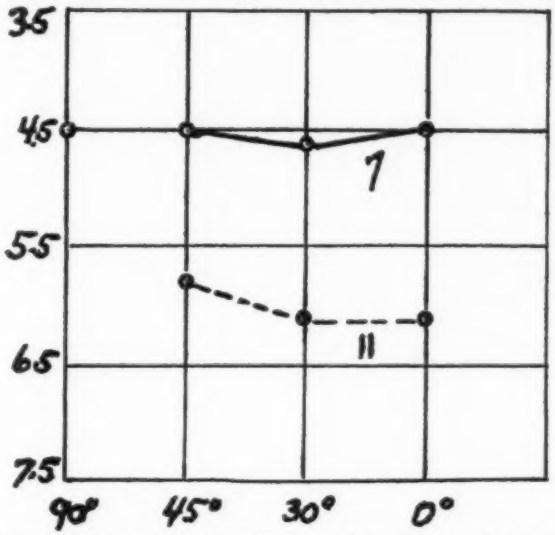

Figure 7. Part 2. Trials 11 and 7. Amplitude at left. Angle of glare source curves for left eye only, at bottom.

Tube or the 3500° daylight incandescent bulb. Add to the above evidence the even further loss of function when this 6000° Kelvin tube was used as a glare source, plus the wealth of clinical evidence, and the conclusion is inescapable. Fluorescent tube light can be quite harmful to the eye because the light around 3000 to 4000 Angstrom units emited by it is in such ratio to other light that it causes the eye media to fluoresce giving rise to a form of glare far less tolerable than that evidenced with incandescent bulb installation.

Our investigation does, however, point to two remedies to this glare problem. One, that every effort be made to install fluorescent light fixtures so that they are at an angle greater than 90° from the visual axis of those working under this type of illumination. Two, that no light entering the eye be reflected from metallic surfaces which in turn do reflect this near violet light. This unfortunately is a theoretical consideration, because it is almost impossible when fluorescent tubes are installed in large rooms, as they are today or when they are used in the fabrication of metallic products.

The third remedy would be to shield the eye from these near-violet

radiations by the use of proper filters. Since this investigation has been started, which is almost one year ago, we have done this with considerable success in our own practice. Optometrists can render a great service to their patients, who must work under fluorescent lighting at the present period in lighting development, by prescribing those filters which reduce the amount of near-violet radiations entering the eye without materially reducing the transmission of the visible light. Of course a better approach would be to shield the lights themselves with proper plastic or glass covers or to use the properly colored glass in the tube or to incorporate powders in the tube which would filter out these annoying radiations. It is our hope that this preliminary report will encourage further and more complete research in this field which will point to corrections which the manufacturers can incorporate in these liminaries to make them the efficient type of illumination they deserve to be.

In presenting this investigation I should like to acknowledge the aid rendered me by Dr. Jack Eglin who acted as a most cooperative subject; to Miss Audrey Lehre, my assistant, and to an illuminating engineer who supplied us with the portable fluorescent fixtures and tubes used in this experiment.

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A CASE REPORT OF ANISEIKONIA OF LOW AMOUNT*

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In a number of articles on aniseikonia the statement has frequently been made that much relief has been obtained by the correction of an aniseikonia of 1% or more. Some writers have either stated that they did not believe the correction of less than 1% beneficial, or have left their readers to infer as much. Since very happy results were obtained recently through the correction of an aniseikonia of only ¾%, the writer felt a report of this case might be of interest.

The patient, Mr. L. C. M., age 62 years, was refracted March 5, 1945, having been referred for an aniseikonic investigation. The patient's history was: "I am very sensitive to light. Eyestrain gives me a stiff neck and my mind stops functioning. If my eyes strain badly, I get nauseated. I have had this trouble for 30 years, and have been shuttling back and forth from the eye man to the stomach man. My eyes water and itch, and if I read where there is an overhead light, the glare of the light causes great eyestrain. I cannot read comfortably for any length of time. My present lenses are not comfortable and never have been, and no lenses have been entirely comfortable, although I can see the print alright. I have sore spots on my eyes."

There was no history of diplopia or difficulty in spatial localization. With the exception of the ocular discomfort and the digestive upsets, his health is good. The external examination was negative with the exception of a slightly hyperaemic condition of the lower lids, tension normal, near point of convergence 2¾ inches, pupillary reactions normal, versions good, fusion on the Wells C8 card good for both perimacular and macular fusion, difficulty in fusing the Wells C7 card (ON NE) with a tendency to suppress the left eye. The last two tests were made through the patient's old correction prescribed two years previously by one of the leading ophthalmologists of the city, O.D. +.75 +1.00 × 180 = V.A. 1.1-1. O.S. +1.25 +.75 × 175 = V.A. .9, VA = OU 1.1, add O.U. +2.25: Correction in Crookes A tint. A previous correction prescribed by another ophthalmologist five years ago was O.D. +.50 +.75 × 175. O.S. +.25 ×1.00 × 5. Add O.U. +2.00. The ophthal-

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moscopic examination revealed normal fundi with clear crystalline lenses.
Vision without lenses O.U.=20/53 O.D. = 20.53-1 O.S. = 20/53-1
Static skiametry: O.D. +.75 +1.25 × 180 O.S. +.75 +2.00 × 180
Subjective: O.D. +.75 +1.25 × 5 = V.A. 1.2 O.S. +.75 +1.25 × 180 = V.A. 1.3-1. V.A. = O.U.1.3+

Monocular cross cylinder: OU +3.00 sphere with subjective cylinders

Binocular cross cylinder: O.U. +2.75 sphere with subjective cylinders

Phoria for distance zero; phoria at 16″ with add +2.25 12△ exophoria, reducing to 7△ exophoria with the patient holding the test card at his accustomed reading position.

Positive relative accommodation 0.50 D. Negative relative accommodation 0.75.

Positive relative convergence 24/16. Negative relative convergence 22/18

(The four previous tests were made through +2.25 add.)

Stereopsis (using two reduced Snellen charts at 16″) fair.

As there was a small difference between the contemplated correction and the lenses the patient was wearing, which might be a cause for some of the discomfort, it was decided to make up a fitover which, when worn by the patient over his lenses, would produce the effect of the new findings. This would indicate to both the patient and the examiner whether or not the refractive condition was the cause of the eyestrain. The patient's report the next day was that the discomfort was as great, if not greater, than without the slipover, and he requested an aniseikonic examination.

The aniseikonic examination was made on March 7, 1945, and a subsequent one on March 15, 1945. The right image was found to be ¾% larger in the vertical meridian with a sensitivity of ±⅜%, and the horizontal meridian of the right eye larger by ½% with a sensitivity of ±½%. The following correction was ordered: O.D. +2.00 — 1.25 × 95. O.S. +2.00 — 1.25 × 90 with ¾% magnification axis 180, add O.U. +2.25, white fulvue bifocals.

The iseikonic lenses were delivered to the patient at noon Saturday, April 7, 1945, and the patient telephoned on April 10, 1945, for an appointment to return for a minor adjustment of the pads of the frame, at which time he reported his eyes were perfectly comfortable, that he could read as much as he wished without any discomfort or headache resulting therefrom, that light and glare did not bother him. A week later a second report was made to the effect that he was still

completely comfortable. Not hearing from him again and knowing he would be quick to complain if there were any discomfort, the writer assumes that the comfort has continued.

No doubt the judgment of the examiner must determine whether or not an aniseikonia of less than one percent should be corrected, but when every other possible ocular cause for ocular discomfort has been ruled out, it might be well to correct even a small amount of aniseikonia which is present.

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VISUAL FUNCTIONING WHILE READING*

A REVIEW OF THE WORK OF THE AMERICAN RESEARCH COUNCIL OF OPTOMETRY

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Since it was not feasible for the Academy to furnish this committee with sufficient funds to conduct reliable controlled experiments in regard to visual functioning while reading, this report will review the investigations of the American Research Council of Optometry.

The American Research Council of Optometry has been active in this particular field since 1934 and furnishes us with data accumulated under well controlled experiments, from the Ord Public Schools; the Teachers College at the University of Nebraska; Claremont College, Claremont, Calif., and the Boulder Public Schools of Boulder, Colo.

An investigation starting at Ord of the visual skills of 2,100[1] students in the Ord and surrounding schools, to ascertain just which visual skills were possessed by the students making the most satisfactory progress in school lead to many experiments in the forementioned educational institutes planned to bring out the best means of improving the desired visual skills.

From the original investigation it appeared that visual acuity[2] was apparently an inherited visual skill since it was at its highest peak in the kindergarten at the average age of five years.

It further appeared that the greatest visual handicap in attaining knowledge was a defective fixation ability. By this is meant the ability to make rapid accurate fixation with both eyes at one and the same time and accurately co ordinated changes to a new point of fixation. This skill is apparently one of the learned visual skills since it did not reach its peak of development until the third grade at an average age of eight years.

The experiments at Ord were with a mixed group of subjects from the seventh to the twelfth grades, inclusive; at the University of Nebraska with students enrolled in the Teachers College, at Claremont; and with the fifth, sixth, seventh, eighth and ninth grade students enrolled in the

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public schools at Boulder. These experiments give a fair coverage of the visual functioning of students from the fifth grade through high school and college.

Methods Used in Selecting Experimental and Control Groups:[6 10 11]

Batteries of educational tests,[9] designed to measure the Scholastic Aptitude of the subjects, were given by qualified educational psychologists to large groups. From the scores made in these tests, students were paired and those scoring approximately equal were assigned, one to the experimental group and the other to the control group. The control group to continue their normal academic routine. The experimental group to continue with their normal academic routine plus the desired visual training. In some experiments a third group was formed to continue their normal academic studies plus specialized pedagogical training in reading, thus giving a second control. In all cases periodic tests were given to the control group or groups at the same time the tests were given to the experimental groups.

Types of Visual Training Used:[7]

The three main types of visual training used were Rotational, a combination Rotational and Stereoscopic, and a combination Tachistoscopic and Stereoscopic.

The rotational stereoscopic instrument in which superimposition is obtained with mirrors has been the most beneficial, rotational training ranked second and tachistoscopi-stereoscopic ranked third.

In some experiments all three types of training were given at each sitting. In other experiments two types were given at each sitting and in still other experiments only one type of training was given at each sitting.

In each experiment significant improvement in reading rate resulted and this improvement was significantly greater than the pedagogically trained subjects used as controls.

Motivation an Important Factor:[11]

Motivation of the subject to arouse and maintain their interest in the visual training appeared to be an important factor. Greater gains were made by subjects volunteering for visual training than by subjects assigned to take visual training. Greater gains were made by subjects receiving the operator's entire attention than where the operator supervised more than one subject at the same time.

Scholastic Aptitude:[10] [11]

Subjects scoring high on the scholastic aptitude test responded more readily to visual training and made far greater gains.

The Field for Optometry in Reading:

Experiments at the University of Nebraska planned to bring out the relative gains in reading rate and comprehension of specialized pedagogical training of reading improvement as compared to visual training showed 62% of the pedagogically trained subjects gained 100 or more words per minute as compared to 90% of the subjects receiving visual training who gained 100 or more words per minute.[3]

The visually trained also made greater gains of the pedagogical tests measuring, paragraph meaning, outlining, vocabulary, etc.

This should not be taken to mean that 28% of the college enrollment were vitally in need of visual training. Experiments at other times or in other schools might show a different percentage requiring visual training. It can be taken to mean that there is a substantial number of students in all educational institutions who would profit greatly from visual training—many more than optometry is prepared to care for.

Recording Eye Movement:

Photography gives a permanent reliable record of the visual functioning in reading[4] if care is used to make sure that the subject is emotionally stable at the time the photographs are taken.

Lining up a group of subjects to take their turn at the camera gives us a picture of their visual functioning under the emotional excitement of the conditions of the procedure and may or may not reflect their normal visual functioning.

Errors of Refraction as Related to Reading:[5]

There has not been sufficient investigation of this subject to assure reliable conclusions. Parkins made a limited study of the problem by having the subject act as his own control in the following manner. First, the reading rate and comprehension were carefully measured. Second, the subject was given the desired correction and the reading rate and comprehension were again taken. Third, the subject was permitted to wear the correction for a month at which time reading rate and comprehension were again measured. Fourth, the subject was then given a pair of plano lenses to wear for a month at which time reading rate and comprehension were again measured.

Following this procedure Parkins found a few cases requiring corrections of less than one diopter who read more rapidly and with better comprehension while wearing the required correction. Parkins found no subjects requiring more than 1.00 D correction who read more rapidly with the correction than without. It must be borne in mind that Parkins used private cases who manifested visual discomfort sufficient to motivate them to inquire about their visual functioning.

Imus[8] reports on 26 cases. Imus arbitrarily concluded that errors of less than 1.25 D were not important and supplied correction for subject exhibiting this amount or more. No attempt was made to obtain any type of control. The results of wearing the correction were gauged by the opinion of the subject combined with the opinion of the instructors. The reading rate and comprehension were measured during the fall term of school and again at the approximate end of the school year. No significant changes were noted.

These two investigators agree on the value of corrections of errors of refraction greater than 1.00 D in terms of reading speed and comprehension. From the little evidence at hand it would appear that correcting the errors of refraction enable the subject to concentrate on near work without visual fatigue and thus enable a student to make better progress in school, although he is not enabled to read more rapidly. Each of us has plenty of evidence to show that students often do make much better progress in school after the errors of refraction are corrected. This subject is worthy of extended investigation.

The Interest of Educators in Reading:

Since reading speed and comprehension control the students' capacity to acquire academic knowledge, educators are vitally interested in the improvement of reading speed with comprehension. For this reason the subject is under constant investigation and study in all progressive educational centers. As a result of these investigations beginning students are now taught to recognize word or phrases instead of first teaching them the alphabet. Later in school they are taught the alphabet and spelling.

Later in school an attempt is made to teach the reading of phrases rather than words since the meaning comes out more clearly when more than one word is recognized at each eye stop and fewer eye stops are required.

Certain mechanical aids have been developed by educators among them being the Metronoscope, developed by the Taylors of Texas. This

instrument exposes parts of a sentence at a time, with the idea in mind of training the subjects to recognize more than one word at each stop and thus reduce the number of stops required to read a line of material.

Buswell of the University of Chicago developed a device consisting of a metal plate mechanically driven that covers the page of reading material, thus forcing the subject to read more rapidly to keep ahead of the plate. As the subject's speed improves the plate can be set to move more rapidly. Buswell also developed a movie film which exposes parts of a sentence at a time with the idea in mind of teaching the subject to read more at each eye stop.

Dearborn of Harvard developed a similar film method of improving reading. Dearborns are available through the Harvard Film Service.

Leavell of George Peabody College for Teachers is using a variation of this film idea. Leavell's idea differs in that he projects the entire page under a low illumination. Then a brighter lighter is focused on parts of the sentence for short periods of time, the light being moved forward at short desired intervals.

Through maintaining an interest in visual functioning while reading, in terms of speed and comprehension, optometry can maintain favorable contacts with educators. For the past several years practically all dissertations on reading contain references to the investigations of the American Research Council of Optometry, thus calling the favorable attention of educators to the profession of optometry.

The American Academy could well afford to support further controlled investigation of this important subject.

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COMMENTS ON A "DELAYED SUBJECTIVE" TEST*

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During the period in which the writer has been engaged in private practice, he has employed a modification of the standard routine, which has been of distinct service in special instances and by means of which he is accumulating evidence of a syndrome of a type of case not always revealed by the standard diagnostic patterns. Because this syndrome has been manifested in only a few cases thus far, it is not the intention of this paper to explain the series of symptoms which comprise it. However, the technique used may be of interest and service to others.

Upon the usual routine cases, it is the writer's habit to take the No. 21 test, the tolerance of accommodative inhibition, or negative relative accommodation, last in the series of findings. This is done by means of the standard procedure of adding plus, a quarter of a diopter at a time, before both eyes. Where the amplitude exceeds five diopters, the subjective correction is in place before the eyes. Where the patient is a presbyope, the tentative reading add is also in place. However, the technique about to be described is useful chiefly where presbyopia is not an element.

When the blurout point is reached, the nearpoint card is removed and the patient's attention is directed to the finest type on the distant chart which the patient had been able to read through the subjective correction. Naturally, this now appears very blurred. The patient is then requested to inform the examiner when this type is again readily visible, and the total No. 21 finding is then reduced, a quarter of a diopter at a time, until that point is reached. The correction remaining before the eyes is then recorded as a "delayed subjective."

If this agrees with the original subjective, it can be assumed that the correction represents the maximum plus or least minus which the patient will accept at the time.

Frequently, however, it will be found that the amount of plus recorded as the delayed subjective is substantially greater than the amount indicated by the original subjective. Theoretical reasons can be advanced for this, - - the longer fog of the test, the accommodative rock effect

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resulting from the juxtaposition of the No. 20 and No. 21 tests, disruption of the fixed status of accommodation by the lengthy routine interposed between the two subjectives, etc.

Whatever the cause, in a number of instances it has been found that the same line of letters is as easily read after this technique has been applied with from .25 to 1.00 diopters more plus than the original subjective revealed.

It is the writer's habit to check the efficacy of the subjective by several methods. One of these is the method known as the threshhold of intensity method. This consists of reducing the illumination of the test chart during the recording of the original visual acuity until a point is reached where the patient can no longer read the best line previously read. The illumination is then slowly increased until the line can be read again. The amount of light required to accomplish this is the threshhold point.

All tests subsequently taken which utilize the distant test chart are performed with the chart illuminated to this extent. (It must be noted that where a patient enters wearing a correction, the threshhold is determined through the old correction if the old correction improves or equals the naked vision.) When the original subjective is completed, the acuity has been measured at this same threshhold. The illumination may then again be decreased until invisibility is reached and again increased until the line can be read. The subjective should be finally recorded as the maximum plus or least minus which grants equal or better acuity than the entrance acuity at not more than the same threshhold of illumination, and if possible at a lesser intensity of illumination. For example, if the patient could see 20/15 through his old correction at a given number of footcandles and the new correction also permitted him to read 20/15 with less light, then the new correction is actually giving him better vision. Obviously, if the same detail can be seen with less intensity of illumination, the acuity is better. Where testing is done above this threshhold to any great extent, it is possible to arrive at a new correction which apparently gives the same acuity as the old one but which actually fogs the patient slightly. The gradations of the test chart are too crude for the fine discriminations of acuity which might be required, and the result is that the patient frequently only notices the blur at "one or two blocks distant."

Subsequent to the readjustment of the threshhold when the acuity of the subjective is measured, the following far point tests are taken with that intensity of light available. When the patient is then unfogged

from the gross No. 21 finding for the purpose of determining the delayed subjective, the acuity which he secures is found at the same threshhold as was the acuity of the original subjective. By this means, the acuity determined through the delayed subjective can be stated to be at least as good as that determined by the original subjective.

However, another method of checking this is also used. The red-green or duo-chrome test is used in both the original and the delayed subjective. Usually, where a doubt exists, the writer prefers to leave the patient slightly "in-the-green," so that blur at distances greater than the testing distance may be forestalled. In comparing the original and the delayed subjective findings, a certain phenomenon has been observed which can be best demonstrated by an actual illustration:

Original subjective:	20/15, + .75, Red better	
	20/15, + .50, Green better	Rx is +.50
Delayed subjective:	20/15, +1.50, Red better	
	20/15, +1.25, equal	Rx preferred
	20/15, +1.00, Green better	is +1.00

It will be noted that the first point at which the acuity apparently equals that of the original subjective is not accepted as the delayed subjective correction, but that the total plus is reduced until a situation paralleling that of the original subjective insofar as the duochrome test is concerned is the one utilized. It will also be noticed that, in some cases, *more plus* following the delayed subjective will leave the green better than left the red better after the original subjective! This would seem to indicate that an actual change in the focus of the eye had been induced, and that accommodation had actually been more relaxed by means of this procedure.

Because the latency apparently revealed may recur readily, the writer has avoided crowding too much of this additional plus. Upon occasion a result such as follows has been found:

Original subjective:	Red better with +.75
	Green better with +.50
Delayed subjective:	Red better with +1.50
	Green better with +1.25
	Green much better with +1.00

With findings such as those described, the plus 1.00 is preferred, since there is no way to distinguish too accurately between the degree of the "better" which was applied to both the +.50 of the original sub-

jective and the plus 1.25 of the delayed subjective. The difference between the .50 which might have been ordinarily prescribed and the 1.00 which seems to be indicated is sufficient to be of import, without pressing too greatly to provide even more plus.

As a final check, the delayed subjective correction is placed in a trial frame and the patient is requested to wear it while the details of the type and style of the correction are considered. This provides the examiner with the opportunity to note whether adaptation to the added plus is easily made or whether blur recurs. The patient may be asked to walk about and look out of the window at greater distances, etc. If blur does recur, then the correction must be modified, but where the routine is followed as described, this seldom happens. Thus far, in only one instance where there was a substantial difference between the original and the delayed subjective findings, has the patient failed to accept the increased plus.

It could be pointed out that the trouble of the routine is hardly worth the results obtained. A patient with difficulty will experience some relief, and perhaps even total relief, from the original subjective correction without the effort and time involved in attempting to increase it. However, it is fairly characteristic of many of these cases that the patients who respond in the indicated manner usually enter the office wearing a correction which is practically identical with the one disclosed by the original subjective and with subjective complaints which indicate that some measure beyond that of the subjective is required. Where either of the illustrations given above applied to patients who had entered the office with a history of ocular difficulty and who wore +.25 or +.50 corrections, the decision faced by the examiner upon the basis of the original subjective alone would have been fairly difficult.

The results revealed by this technique have been found in a limited number of instances. It apparently serves to reveal certain spasms of accommodation. The cases have, as mentioned earlier, also shown certain characteristic arrangements of other findings but, because the total number of cases is small, the writer is hesitant about announcing a syndrome until more evidence is accumulated. Those who decide to use this technique are requested to accumulate their results so that the total mass of findings of several examiners may be used to develop the existence and form of a syndrome, or the absence of one, as the case may be.

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LIGHTING AND SEEING

In this issue an article by Goodlaw[1] is published dealing with the particular visual fatigue at times engendered by the misuse of artificial illuminants. The author, a Los Angeles optometrist, has attempted to analyze the extent of this fatigue as well as its possible cause. His work is of interest as the complaint mentioned by him is one heard in every refracting room in America, almost daily.

To be sure, Goodlaw's findings are open to possible criticism as he fails to qualify as an illuminating engineer. On the other hand, Goodlaw is an optometrist and as such does qualify as a visual specialist and irrespective of meticulous work on the part of illuminating engineers, if this work fails to produce visual comfort under otherwise normal conditions, both ocular and working, something must be done about it, as workers will not tolerate visual discomfort for long periods of time.

As Luckiesh[2] has pointed out, glare has been studied from many aspects and there is no evidence that glare is a function of the spectral character of light. He explains that glare is a matter of brightness of glare-source, the brightness-ratio between the glare-source and its surroundings, the candlepower toward the eye, the angular distance of glare-source from the line of vision, the state of adaptation, etc. All of these relationships have been quite well worked out. He further points out that many optometrists and others have confused light and lighting. They have condemned fluorescent lamps because an installation was glaring. The condemnation should be directed to the misuse of the lamps. If we have a tube emitting light such as the fluorescent lamp, it will be glaring under certain improper conditions. If one would replace that luminous tube with a tube of diffusing glare containing a tungsten-filament, there would be no significant difference in glare if the two tubes were of the same brightness and located in the same place under the same conditions. Goodlaw, however, does not agree with this last conclusion.

Luckiesh himself has criticised many installations of fluorescent lamps because these bare lamps were in the visual field of the worker while he was performing critical seeing. This, however, was not a criticism of fluorescent lamps but rather of their misuse. Luckiesh believes that it is a very simple matter to shield these lamps. He claims in large offices and plants that there is no excuse for having many of these bare lamps visible to the worker. His prior research has indicated that fluorescent lamps are more than twice as efficient as high wattage filament lamps and suggests the use of indirect lighting using fluorescent lamps as more practical than the present system of using indirect lighting with filament lamps. This would perhaps meet Goodlaw's criticism.

An article, "Radiant Energy from Fluorescent Lamps" by Matthew Luckiesh and A. H. Taylor will be published in the October, 1945, issue of this journal which will present to the profession additional data on this important subject.

CAREL C. KOCH.

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[1] Edward I. Goodlaw. Visual Discomfort Caused by Fluorescent Lighting.

[2] Matthew Luckiesh. Lighting Research Laboratory. General Electric Company. Nela Park. Cleveland, Ohio. Letter of July 6, 1945, to Dr. R. M. Hall of the Editorial Council of the American Academy of Optometry.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

DATES SET FOR ANNUAL MEETING OF ACADEMY

The 1945 annual meeting of the American Academy of Optometry will be held on December 9, 10, 11, and 12 at the Deshler Wallick Hotel, Columbus, Ohio, with several of the sessions scheduled at the School of Optometry, Ohio State University.

The O.D.T. has increased the number of out-of-town members who may attend a convention from 50 to 150. Since this is slightly in excess of the number of out-of-town members who ordinarily attend our meetings, there is apparently no need to apply any restrictions on the attendance.

Members who plan to attend and members who wish to contribute papers are urged to advise the chairman of the Papers Committee, Dr. H. W. Hofstetter, School of Optometry, Ohio State University, Columbus, Ohio, at once if they have not already done so.

Members who plan to attend are also urged to make hotel reservations at once through the Deshler Wallick Hotel, Columbus, Ohio.

NEW JERSEY CHAPTER

The New Jersey Chapter of the American Academy of Optometry opened its fall sessions on September 12, 1945, at the Stacy Trent Hotel, Trenton, New Jersey.

The program began at 4:00 P. M. with a lecture on binocular space perception anomalies caused by unequal ocular images, given by Dr. Harold M. Fisher of New York City. At 6:30 P. M. dinner was served and the second portion of Dr. Fisher's lecture took place. Dr. Fisher is Vice President of the American Academy of Optometry and is well known throughout the East for his work in aniseikonia.

The following optometrists are members of the New Jersey Chapter of the American Academy of Optometry. Drs. Wilbur Aurnhammer, George Brown, Henry Bisbee, Paul B. Goss, Ernest Giglio, E. Burton Hudson, Phillip Jackman, George J. Jukas, Bernard Kushner, Ernest E. Linke, Ethel Manukas, J. W. Morey, George A. McEaney, Arthur

R. Neale, Jr., E. C. Nurock, Julius Neumueller, W. H. Nicklin, Herbert Purnell, Alexander Price, Earl J. Ridgeway, L. M. Ratliff, Herbert Ratliff, A. A. Rhodes, Harold Simmerman, R. M. Shindler, George Sheppard, John A. Steeve, William Schumann, Howard Steeve, William A. Wirth, J. H. Wittekind, Joseph Wurtzel, and W. Zolton.

GRANT FOR WORK ON VISUAL FUNCTIONS

American Optical Company has given Yale University, New Haven, an additional grant in further support of the research program of the Clinic of Child Development of the School of Medicine.

The grant covers the three year period 1945-1948 and finances investigations of the development of visual functions in the first ten years of life.

The research work is being conducted on a cooperative basis by a medical and psychologic staff under the direction of Dr. Arnold L. Gesell, professor of Child Hygiene and director of the Clinic and Child Development. Chief emphasis is being placed on problems of early diagnosis and of preventive control.

AO's first grant for this research was announced last year.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics
12. Miscellaneous.

1. OCULAR REFRACTION

CORROBORATION OF EYE IMPRESSIONS (FOR CONTACT LENSES) WITHOUT ANESTHESIA. J. S. Nupuf, et al. Optometric Weekly. 1945, 34, 9, 237.

The authors present a report on taking eye impressions for contact lenses without using topical anesthesia (½% pontocaine) or vaso-constrictor. (1:1000 adrenalin). Five impression trials were made. Moldite impression powder, and the large size casting shells were used.

The Nupuf technique of taking impressions was followed in each instance.

The clinical observations compiled for this report are as follows:

1. No discomfort was felt when the casting shell, filled with the impression material, was inserted under the eyelids and adjusted for accurate positioning.

2. A cool, soothing sensation was experienced while the impression material was setting.

3. An accurate control was maintained by the fixating eye without any stimulation to the blinking reflex.

4. A feeling of bulkiness and slight stretching to the eyelids was reported. (This same sensation is noticed when anesthetics are used.)

5. The suction of the impression material upon the eye is more readily broken, facilitating the removal of the casting shell. No discomfort, other than bulkiness was experienced. (Note: The more easily broken suction was possibly due to the regular lacrimal flow and the normal irregularity of the bulbar conjunctiva, since drugs were not used.)

6. Moderate injection of the bulbar conjunctiva was present after the casting shells were removed. This injection, however, disappeared in from five to 15 minutes. Ciliary injection was absent, indicating no irritation to the corneal tissue.

7. Corneal inspection under magnification proved negative.

8. The eyes felt immediately comfortable in all cases and visual acuity was unimpaired.

9. A second impression was taken with similar results with only slight irritation to the upper lids.

10. No burning, increased lacrimation, induced mucous formation or scratching sensations were experienced in any instance. These symptoms are often the rule when drugs are used.

11. Accurate positive castings were obtained in most cases. One of the doctors taking impressions for the first time obtained excellent castings, proving that this method does not require long experience in taking impressions.

12. In the absence of drugs, a patient would be able to feel carefree and unnecessary irritation to the eyes would be eliminated, thus preventing possible damage to the tissues. C. C. K.

TELESCOPIC SPECTACLE RESTORES NEAR VISION. L. A. Swann. The Optician and British Optical and Instrument Journal. (London). 1944, 108, (No. 2801), p 290.

Swann reports a case in which a male patient, age 70, was enabled to read with the left eye by means of a Barrett telescopic monocular. The right eye was occluded and the telescopic spectacle used before the left eye. With an ordinary correction only very large type could be read. With the new correction all ordinary type is read with ease at nine inches.

A.V.F.

EYE IMPRESSIONS WITHOUT ANESTHESIA. S. M. Braff. Optometric Weekly. 1945, 34, 6, 149.

Braff claims that molds for making contact lens casts may be made directly on the patient's eye without resorting to ocular anesthesia by using the technique he briefly reviews.

T.O.B.

WHY BOTHER TO TAKE VISUAL SKILLS? C. Venard Lyons. The Pennsylvania Optometrist. 1945, 5, 4, 2-11.

Lyons believes that visual skills should be studied in every case. He points out that (1.) Average achievement does not necessarily indicate the absence of a visual problem. Many students with a high I. Q. may have a potential of achievement well above average. Yet a visual problem may lower this potential to just average. In the presence of a visual problem, lenses, training or both are indicated even though achievement is average.

(2.) Lowered achievement may not be definitely manifest in a set of Visual Analysis findings. In an effort to maintain clear and single vision, the patient may have shifted his findings almost to the point of eliminating the case typing which indicates the source of his problem. But in the process of making these compensations, achievement is lowered. In the presence of lowered achievement, one must look closely at a set of findings that might otherwise be thought to vary but little from the expected.

(3.) In the early presence of a visual problem (accommodative or convergence) achievement may not be lowered materially. When the working load increases enough to force the student to make compensations, then achievement starts going down.

(4.) A visual Analysis locates the source of a visual disturbance. Visual Skills indicate what the organism has done about the visual in-

terference. Both are necessary for an adequate interpretation.

(5.) A battery of Visual Skills will include: 1. Visual Acuity, right, left and binocularly in the presence of depth. 2. Fusion. 3. Stereopsis. 4. Hand and eye coordination. 5. Rotations and Versions. 6. Fixations. 7. Cover test. 8. Comprehension reading speed.

A.V.F.

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2. PHYSIOLOGICAL OPTICS AND COLOR VISION.

THE VISUAL EFFECT OF NON-UNIFORM SURROUNDS. P. Moon and D. E. Spencer. Journal of the Optical Society of America. 1945, 35, 3, 233-248.

"The paper presents an analysis of the effect of non-uniform visual fields. Three conditions are considered: (a) Eyes fixed on the work, effect of non-uniform surround is evaluated. (b) Steady-state adaptation to any part of the visual field, effect of suddenly looking back at work is evaluated. (c) Transient conditions, criterion is the unpleasant sensation rather than the reduction in vision.

"Condition (a) is a necessary step in the study of (b). It is of practical importance in some cases such as glare from automobile headlamps but does not seem to be of much importance in the establishment of a criterion for room lighting.

"Condition (b) leads to the important theoretical conclusion that for best vision *no part of the field should produce an adaptation helios more than* 3 *times or less than* $\frac{1}{3}$ *the adaptation helios of the work.*

"For large surfaces, the values of adaptation helios are practically equal to the values of helios for the surfaces. For small surfaces, the actual helios ratio can be greater than 3 without violating the above criterion. Equations and graphs allow calculation under all conditions.

"Condition (c) makes use of a recently developed photochemical theory of vision. The theoretical curves are in fairly good agreement with the experimental work of Nutting and of Holladay. Both theory and experiment indicate that very large helios ratios may be employed safely at low helios levels. Over the range of good interior lighting, however, the curves are fairly flat and tend to corroborate the criterion of (b)."

T.O.B.

SOME ASPECTS OF VISION AS A FUNCTION. I. L. Shapiro. Optical World. 1944, 32, 12, 16.

"Briefly the functional approach to visual problems contends: (1.) Vision is a function in which the whole body participates. (2.) Two

separate though interrelated parts of the nervous system control the motor aspect of the function of vision: (a.) Voluntary nervous system—controls the placement of a pair of eyes—the act of triangulation or convergence. (b.) Autonomic nervous system—controls the focusing of the eyes, referred to as accommodation. This is involuntary control. (3.) The seat of efficient or inefficient control and function of a pair of eyes exists in the brain and other parts of the central nervous system. This control is referred to as the neurological pattern of visual organization. It is not located in the eyes themselves. (4.) Because of the habitual close relation between the use of triangulation and focus, any stimulation or inhibition to one function will tend to affect the other function in a like manner. (5.) In order for a pair of eyes to function harmoniously it is necessary that slack exist in the central nervous system between the neurological patterns of focus and triangulation. If no such "cushion" existed, any excessive stimulation to convergence would bring an excessive stimulation to accommodation and blurring would result. Likewise excessive stimulation to accommodation would bring about a doubling due to reciprocal innervation to convergence. (6.) A limited amount of hyperopia forms the necessary area of compensation to protect the integrity of the pattern of focus. Likewise, a limited amount of exophoria forms the necessary area of compensation to protect the integrity of the pattern of triangulation. (7.) From this basic approach it is reasoned that visual problems result from disharmony between the neural pattern of control of these two functions (patterns of focus and triangulation) in the central nervous system. (8.) These disharmonies are basically brought on by "reading", where "reading" is broadly defined as any maintained, sustained concentration within a restricted area of visual activity. (9.) Visual concentration in a restricted area of movement is considered an artificial task. Any artificial task will cause a "shift" or even absorption of "slack" between patterns. In the latter case symptoms of discomfort frequently arise. Thus, discomfort is often associated with undesirable phorias; hyperopia in excess of the amount needed to protect the integrity of accommodation; dis-equilibrium between patterns; the loss of visual skills, etc T.O.B.

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4. ORTHOPTICS AND READING

EYE EXERCISES—DO THEY DO ANY GOOD? DO THEY DO ANY HARM? THEIR LIMITATIONS. Walter B. Lancaster, The Sight-Saving Review. 1944, 14, 3, 139-150.

The answers to the questions, says Lancaster, are obvious: eye exer-

cises do a great deal of good. They are indispensable in learning to see. They may do harm indirectly if they divert a patient with some disease needing treatment of some special kind so that he is led to follow treatment by exercises instead of consulting a competent ophthalmologist and finding out the true nature of his trouble. The limitations to treatment by eye exercises are also clear. It cannot affect certain physical conditions but is potent in treating the psychic side of vision. It requires a very high high degree of skill and acumen to steer a true course, avoiding the neglect shown by many otherwise competent specialists and avoiding the excesses of over-zealous enthusiasts.

A.V.F.

REGARDING VISUAL TRAINING. S. A. Wheatley. The Mid-West Optometric Journal. 1945, 12, 9, pp. 14-15.

The author urges all optometrists to engage in orthoptics. He points out that each optometrist must of course decide how much of this work he will do himself and how much he will delegate to his assistant. If however he does delegate the work he must keep same under his close supervision. C.C.K.

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6. OCULAR AND GENERAL PATHOLOGY

RETINAL DETACHMENT—A CASE REPORT. D. W. A. Mitchell. The Optician and the British Optical and Instrument Journal. (London). 1945, 109, (No. 2814), 70-71.

"Mr. C. E. S., aged 63, has been wearing his present corrections for about three years, and whilst that for distance was still satisfactory, he was experiencing slight difficulty with the reading one—that was why he had come. The enquiry into symptoms and history revealed that he occasionally saw flashes of light, but apart from this and the reading disability there were no complaints—no headaches, pain or other discomfort, no general symptoms, no reason to suppose that his general health needed attention.

"The refraction offered no difficulty; with the new distance correction monocular vision was 6/5 in both eyes, and a reading addition of + 2.00 enabled him to read J1. The oculomotor balance was within normal limits.

"A cursory examination for abnormal conditions would have given negative results, too, for externally there was nothing to arouse suspicion, the media were clear, and the disc and vessels normal. But a careful, systematic exploration of the fundus revealed two conditions which changed the picture of the case completely. At the macula was a minute

haemorrhage or aneurysm, smaller than a pin's head, and very difficult to see with the pupil undilated, as this one was. In the lower temporal periphery was a small detachment, dull, greyish and ill-defined, but unmistakable with its dark retinal vessels which could be focused with about 6D more plus than was required for the surrounding normal area.

"A point to be stressed here is that this detachment could not be seen with the patient's eye directed straight ahead. It was so far out in the periphery that to bring it into view the eyes had to be turned down slightly.

"No prescription for lenses was given: the patient was referred to an ophthalmic surgeon. The latter's report not only confirmed the diagnosis of detachment, but also expressed the opinion that the cause was a malignant tumour." T.O.B.

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7. OPHTHALMIC LENSES AND MATERIAL

COATED LENSES. D. C. Putnam. Optical Journal and Review of Optometry. 1945, 82, 6, 28.

A new process makes an optical lens more efficient in the transmission of lost light. "Lost" light is the light lost by reflection when it strikes the surface of a lens. The average optical lens transmits only ninety-two (92) per cent of the light striking it.

This new process utilizes a thin molecular film of a substance with a lower index than the glass. It is coated on the surface of the lens and is as hard as the glass itself, both durable and tenacious. A lens with this coating, otherwise spoken of as a low-reflecting film, will transmit nearly ninety-six (96) per cent of the light otherwise lost by reflection: that is to say, better than forty-five (45) per cent of the lost light is utilized.

The coating of low-reflecting films onto the surface of optical elements is by no means completely new. It has been developed and perfected by both the Army and Navy and is today required in the specifications on all precision optics manufactured for them. There are several types of low-reflecting films, both hard and soft. The one discussed in this article is the one required by the Army and Navy.

T.O.B.

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8. INSTRUMENTS

IS RETINOSCOPY BY INSTRUMENT A FUTURE POSSIBILITY? H. S. Marshutz. Optical World. 1945, 33, 7, 20.

The author comments on a new instrument recently patented by a New York physician in which a photoelectric cell is used in place of

the refractionist's judgment in making a skiametric test. The test works, according to Marshutz, by combining the principle of the photoelectric cell and the known principle of optics that the illumination of the retina during retinoscopy is brightest just within and just beyond the point of reversal. The new instrument brings within the realm of possibility a definite determination of the error of refraction (spherical and cylindrical) through the guidance of a scaled meter which is influenced by the action of a given light quantity upon the electric cell device. This light-quantity varies in direct proportion to the correctness of a lens placed before the eye, but such variations may be too small to be accurately gauged by the eye of the refractionist. Here is where the photoelectric cell can note the variations no matter how slight.

T.O.B.

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11. EDUCATION, SOCIOLOGY AND ECONOMICS

INDUSTRIAL FIRST AID—EYE INJURIES. L. H. Whitney. The Sight-Saving Review. 1944, 14, 3, 183-189.

The author points out the soundest approach to the problem of eye injuries is a good program of eye protection. However there is still a need for a good program of prompt and skillful management of industrial eye accidents and he reviews such a program. In this paper he mentions a fact little commented on in our literature. This has to do with industrial fluorescent lighting which became so widespread in its use in our newer war plants. These lights, claims Whitney, caused numerous complaints on the part of workers who claimed their vision was uncomfortable when working under them. Whitney found no serious ill effects of this, but did find that some workers had to use protection glasses or lenses with some absorption quality to get relief. C.C.K.

VISUAL EDUCATION DEPARTMENT IN THE SCHOOL SYSTEM. A. C. Holland. Visual Digest. 1945, 8, 4, 11-13.

Holland believes that school systems should provide a department to thoroughly investigate the visual fitness of all children on entering the school system. He points out that vision is a learning process in part and is not wholly a health problem. T.O.B.

EDUCATING OUR EYES. Clifford L. Treleaven. Columbia Optometrist. 1945, 19, February, 2-3.

Treleaven believes that on the whole we have done only a fair job of taking care of the visual needs of the public and cites the large num-

ber of young men found to have faulty vision on entering the military services. The extent of this neglect on a national scale has been pretty forcefully brought home to us by the war emergency. Among the specific reasons for rejection for military service of our American men of fighting age, eye defects ranked only second from the top of the list. And in our war industries, geared for top production, with thousands of workers at new types of work for long hours, the incidence of eye defects and visual handicaps has been shocking. It has constituted a definite threat to the war effort—according to some surveys—running to almost 50% of the workers. The human waste and inefficiency were there all the time but the national emergency has shown it in bolder relief.

We are all determined that the toll of visual defects, lost fighting men, lost production and visual inefficiency so sharply revealed by the war emergency, a large part of which was preventable, shall not continue in the post-war period. Moreover, for a time many war-injured eyes will have to be aided with especial optical devices and many of them will need special training and visual rehabilitation. Whatever the program, it must be based on the services of experts in vision who must be given sufficient time in each individual case to make a thoroughgoing visual analysis to determine the nature and source of the difficulty and to recommend the best remedy. They must be in a position to give an unbiased opinion.

To train such experts is the principal task of our accredited optometry schools distributed over the nation. All of these now offer a minimum of four years of training which is constantly being modified and expanded in the light of new knowledge, new techniques, and new instrumentation in the field of vision, some developed in their own laboratories, some elsewhere in the profession or in allied fields.

Optometry has reason to be proud of its schools and the high standards of practice which they try to teach even though, unfortunately, these are not always lived up to by some. We all know that these standards cannot remain static but must constantly go forward. To young men and women of high character, integrity and competence, Optometry in the post-war world offers almost unlimited opportunities to render a concrete, satisfactory and valuable service to individuals and through them to our nation and to humanity. T.O.B.

INDUSTRIAL EYE CARE. R. M. Hall. Optical World. 1945, 33, 7, 32.

In reviewing, says Hall, the picture of industrial eye-care, one fact

becomes worthy of consideration and discussion—the fact that the correction of improvement of visual characteristics of employees by means of spectacles or other eye treatment involves specialized professional services. It becomes increasingly apparent and important too, that optometrists who seek to become consultants to, or practitioners for, industry must be able to evaluate the requirements of employees not only with regard to their normal visual requirements but also with regard to the specific demands put upon them by the job they hold. The professional man must, in other words, become more or less a specialist in a specialized field.

Since ethical optometrists and ophthalmologists are restrained, by their own code of ethics, from advertising or seeking employment, the choice of men to pursue industrial visual programs must devolve upon industrial management, claims Hall. In attempting to locate qualified professional personnel, management is seeking out those who have proved by their ethical standing in their own communities and among their professional colleagues that they have the professsional qualifications needed to deal with a large group of individual employees. Management is looking for men who, because of their interest in problems of industrial vision, have devoted much of their time, energy, and study to the determination of individual needs with regard to job visual requirements, near-point refraction, safety legislation and specifications, and the whole sequence of related subjects. Management will undoubtedly seek these qualifications whether it is proposing to hire a professional man full-time and set up an office for him at the plant, whether it plans to use him on a visiting-consultation basis, or whether it plans to send the individual employees to him for treatment.

In view of this probable sequence of events, then the point made by Hall at the beginning of this article takes on its true importance. It becomes, in reality, the core of the vital problem of effecting satisfactory and mutually beneficial relationships between industry and the professions. It places as well the full responsibility where it should be placed—upon the professional man whose legal and social commitment is the care of eyes, be they industrial eyes or any other kind. It indicates clearly the coursee which must be followed if industrial-professional cooperation in the matter of industrial visual safety and efficiency is to grow to its full and proper status—a powerful and well-coordinated united effort toward the goal of ever-increasing improvement of the visual welfare of the individual industrial employee.

Clearly, then, Hall points out, the steps along the road toward

successful integration of professional eye-care into the industrial pattern are 1) the acquiring on the part of the practitioner of the specialized knowledge necessary to interpret and provide for the visual needs of industry, and 2) the development on his part of the highest possible standards of ethical conduct and a broad understanding of his social responsibilities. A.V.F.

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12. MISCELLANEOUS

ECONOMICS OF AN OFFICE LOCATION. S. Albert. Journal of the American Optometric Association. 1945, 16, 6, 135-136.

The author at one time practiced in an office located on the ground floor in the business area of Nashville. He then moved his office into a standard professional location in a modern office building. As the result of this move Albert observes that he now does his refractive work more efficiently. He has better relations with both his patients, the public and other professional men. He finds too, that his volume of refractions is equal to the totals refracted before making the change and in addition his office overhead has been reduced. He finds also, that he has more time for orthoptic treatments and from the general tone of the report he seems to be getting more fun out of his work today than before. C.C.K.

THE OPTOMETRIC ASSISTANT. Caryl Croisant. Associated Journal of Optometry. 1945, 10, 9, 5.

Croisant suggests optometric assistants be trained in orthoptic techniques through a standard training program arranged on a national basis and that assistants so trained be given standard examinations and certificates which qualify them as optometric assistants. A.V.F.

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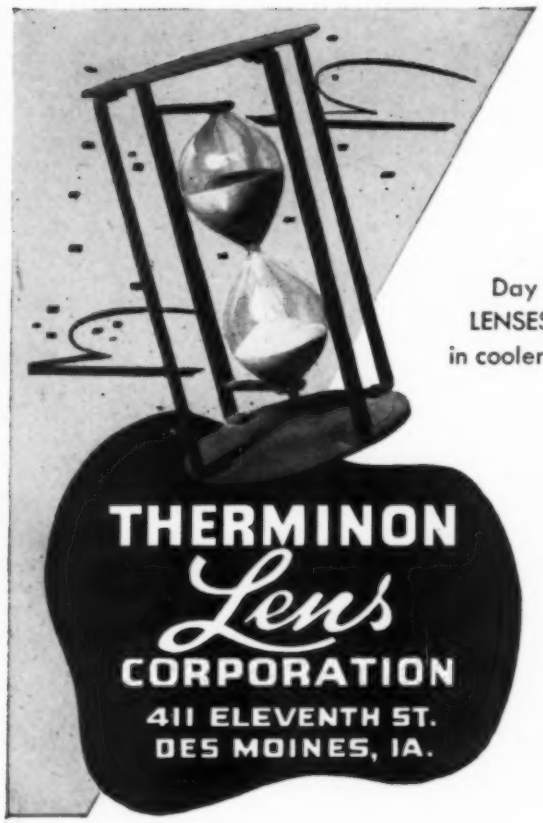

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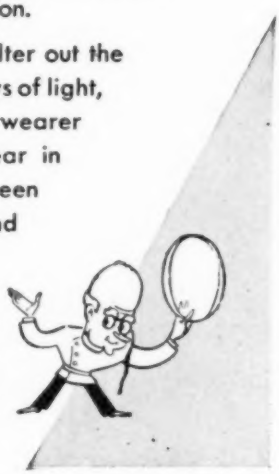

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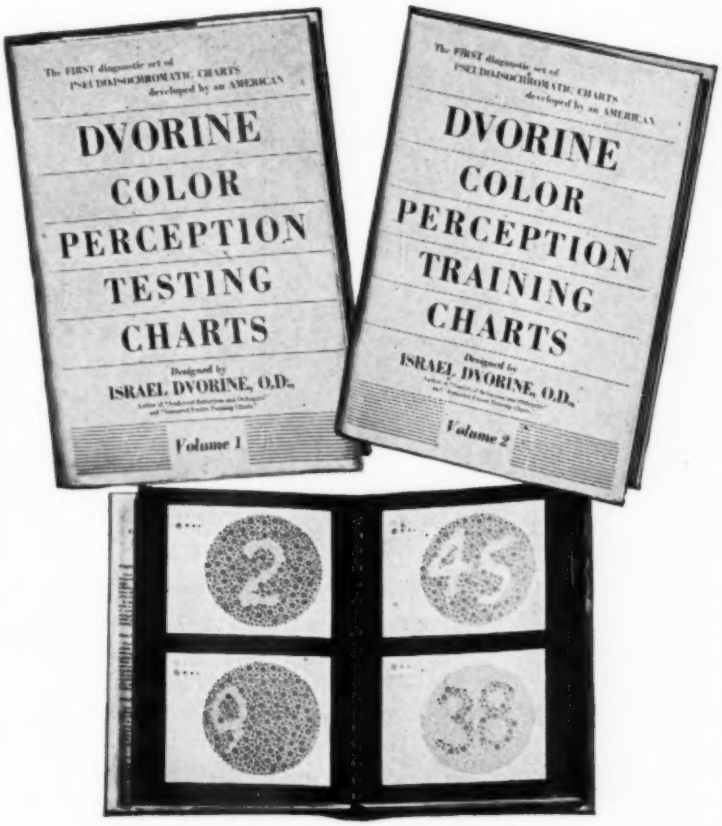

There is a growing conviction among investigators of color vision that true color-blindness is extremely rare and that the large number of partially color-blind individuals are merely confused when required to discriminate between colors of the same intensity. Many of these patients are color ignorant as well.

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